VANUATU

TOWARDS SUSTAINABLE FORESTRY

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Abstract

Vanuatu is a "Y" shaped archipelago with a total land area of 12,189 km^2. At present about 1/3rd of the country is forested, of which 116,640 ha is estimated to be loggable. The forest industry has grown over the past fifteen years to a point where it contributes about 10% of the country's economy and is the country's third largest export earner. Vanuatu banned round log exports in 1993 in a move to establish a local sawmilling industry; the value of exports of sawn timber exports was 233 million VT in 1995. The Government released a comprehensive National Forest Policy Statement in 1997 that aims to establish a sustainable industry. The Department of Forests, with the assistance of AusAID, is developing the capacity to regulate and manage forestry operations, and has the capacity to be fully self-funding from license fees and other royalties.

Vanuatu has a good forest resource database but there has been some debate over the sustainable rate of utilisation. Most estimates are made on a national basis; this overlooks the fact that the vast majority of commercial timber resources are located on two islands, Espiritu Santo and Malakula. An assessment of the forest sector based on the ITTO criteria suggests that Vanuatu is well on the way towards developing a sustainable industry. But the present commercial logging operations are not sustainable as they are concentrated on two islands, Espiritu Santo and Malakula, and at present rate of utilisation the known resources of these islands will be exhausted in about 14 years. There is an urgent need to ensure the regeneration of the species now used by the industry is enhanced in native forests, and to establish commercial plantations. Some recommendations are made for action by the GoV that will ensure the establishment of a sustainable forestry sector.

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This report is essentially a literature review. I have attempted to obtain the most up to date reports on the forestry sector in Vanuatu but as the sector is subject to constant change I have had to draw an arbitrary line and have not included information or developments that have occurred after June 1998.

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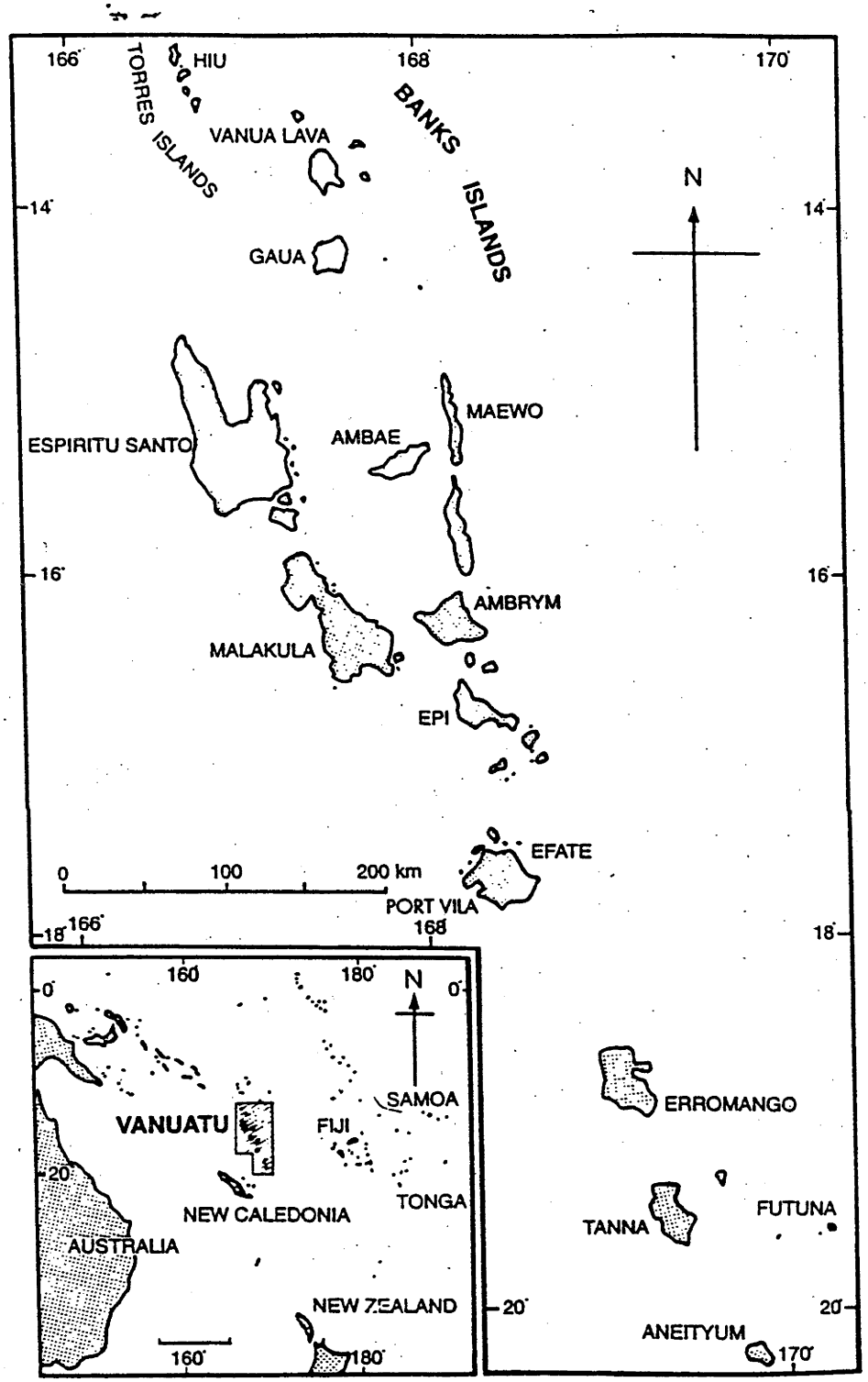
Abbreviations and Acronyms

ADB	Asian Development Bank
AusAID	Australian Agency for International Development (formerly AIDAB)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
cm	centimetre
dbh	diameter (at) breast height
DoF	Department of Forests
EU	European Union
FAO	Food and Agriculture Organisation (of the UN)
FRIS	Forest Resources Information System
fob	free on board
GDP	Gross Domestic Product
GoV	Government of Vanuatu
ha	hectare
ISP	Industrial Supply Plantation
ITTO	International Tropical Timber Organisation
km	kilometre
km^2	square kilometre
m	meter
m^3	cubic meter
m^3/ha	cubic meters per hectare
m^3/yr	cubic meters per year
NGO	Non-government Organisation
RMU	Resource Mapping Units
SPC	Pacific Community (formerly the South Pacific Commission)
SPREP	South Pacific Environmental Programme
SPFDP	South Pacific Forestry Development Programme
SPF&TSP	South Pacific Forests and Trees Support Programme (a successor to the SPFDP)
LSP	Local Supply Plantation
LUPO	Land Use Planning Office
UNDO	United Nations Development Programme
VANRIS	Vanuatu Resources Information System
VT	Vatu (the currency of Vanuatu) ~ VT 80 = $Aust 1
$Aust	Australian dollars
$US	American dollars



Map 1. The Republic of Vanuatu

1 Introduction

Although the humid tropical forests only cover six to seven percent of the earth's land surface, they serve as one of the world's most important storehouses of biodiversity; they are variously estimated to contain at least half of the world's species. Tropical forest species are vital components of modern agriculture, medicine and industry, but the rate of deforestation of tropical areas has continued unabated for several decades. Faced with growing populations, a need to increase agricultural production, a desperate need for foreign exchange, and limited natural resources, for many tropical countries whether to exploit their forest resources is not even a question (Blakeney & Davies, 1995; D'Silva and Appanah, 1993; Johnson and Cabarle, 1993)

Satellite imagery indicates that the annual rate of tropical deforestation increased by at least sixty five percent over the decade 1980 to 1990. It is estimated that half the original tropical forests have disappeared, and at the present rate of decline little closed primary forest will survive beyond the year 2000 outside protected areas and in the remote, and largely inaccessible areas of Amazonia and Irian Jaya/ Papua New Guinea (FAO, 1988 and 1991).

Governments have to address several issues, some of which are mutually exclusive. On the one hand there is economic pressure to harvest their countries' forest resources, often to earn foreign exchange for development of other priority sectors, and on the other there is the need to protect the culture and livelihood of indigenous forest dwellers. Governments have to meet the needs of landless poor, and to balance this with the economic and environmental value of forests. There is growing awareness that in many cases the value of non-timber forest products may be greater than the value of the wood in the forests (Chapter 5). The estimated total value of world trade in non-wood forest products is estimated at about US$ 11,000 million (Braatz, 1997).

The adverse effects of tropical deforestation are felt on both a local and global scale. Tropical deforestation has been directly linked to flooding, sedimentation, water shortage, landslides, and productivity losses in coastal ecosystems. Johnson and Cabarle (1993) note that on local and regional scales deforestation is thought to be

associated with increased surface temperatures, changes in hydrology and, it has been suggested to be it is thought to be a decline in rainfall. They also note that clearing tropical forests is linked to an increase in atmospheric carbon dioxide, which could be contributing to global warming, and a change in global climate patterns.

The three most important causes of deforestation are clearing for agriculture or pasture; meeting the demand for firewood and fodder; and commercial logging. Fire, intentional and natural, also contributes to deforestation. The extensive forest fires in Kalimantan and the island of New Guinea during 1997 and 1998 are good examples of the devastation that can result from fires caused by commercial logging operations and land clearance for agriculture.

The present crisis in the world's tropical forests can be attributed to three common weaknesses in the Governments of many developing countries; failures in economic policy, and a lack of institutional and technological capability. Failure of economic policy can be attributed in large part to the divergence between private and social costs. Those who gain most from logging or land clearance seldom pay a fair share to compensate for the adverse impact of these activities. Governments often compound these problems by setting stumpage fees below the true replacement costs because they do not know what the true replacement costs are. Institutional weaknesses can be attributed to a lack of appropriate government policy, lack of political support, inadequate funds, a shortage of trained staff, an inability to establish appropriate regulations and to monitor and enforce them, and a loss of the confidence of local communities. Technical shortcomings include an inadequate knowledge of forest dynamics, inability to plan and control harvesting, inappropriate harvesting techniques and a lack of research capability. The challenge is to find a way to maximise the economic potential of tropical forests without destroying them.

Although most attention has been focussed on deforestation in Amazonia and South East Asia, including the Indonesian archipelago and the Philippines, the Pacific Islands have not been immune. The ban on log exports from Indonesia during 1980 – 1985, and from Sabah in 1993 saw traders move into Papua New Guinea and Solomon Islands (Dauvergne, 1997). Deforestation and forest degradation due to commercial logging and the clearing of land for agricultural activities are now

widespread in the Pacific. Not only are present harvest rates in many Pacific islands unsustainable, harvesting is generally being done in a highly destructive manner; causing widespread damage and inhibiting the already slow rate of natural regeneration (Blakeney and Davies, 1995).

These problems are particularly acute in small island countries as they have a small resource to start with, and therefore have a smaller margin for error if they are to maintain their forests in a healthy and productive state.

The Melanesian countries, Papua New Guinea, Solomon Islands, Vanuatu and Fiji all have areas of native forests that are being commercially exploited. The role of forestry in the economy of these four countries is very different. Papua New Guinea and Fiji have mixed economies, and have other industries producing the majority of their export earnings. Forestry is an important revenue earner for Vanuatu and is a growing source of export earnings, whilst Solomon Islands rely almost totally on the export earnings of their forestry sector.

Vanuatu took a different policy direction to most tropical countries in 1987 when the government banned the export of unprocessed logs. The Vanuatu sawmilling industry now meets domestic urban needs and provides a small quantity for export. The aim of this paper is to examine the forest sector in Vanuatu to assess whether it is sustainable, and whether the Vanuatu experience has lessons for other tropical countries with commercial forest resources.

This report is an appraisal of the present situation in Vanuatu and identifies initiatives that will have to be implemented if Vanuatu is to achieve its aim of sustainable forestry.

2 Vanuatu's natural environment

2.1 Geographical background

Vanuatu is located in the South West Pacific approximately 800 kilometres south east from Solomon Islands, the same distance west from Fiji and about 400 kilometres north east of New Caledonia (Map 1, page vii). Vanuatu is an 850 km long 200 km wide 'Y' shaped archipelago with over 80 widely dispersed islands in a north-west - south-east orientation from the Torres group at 13^0 south 166^0 east, to Aneityum Island at 20^0 south 170^0 east. The total land area is 12,189 square kilometres but the eight largest islands contribute 87% of this, with Espiritu Santo and Malakula comprising 4,248 (34%) and 2,053 (17%) square kilometres respectively (GoV, 1993; Weightman, 1989)

The islands of Vanuatu are the crests of a partly submerged volcanic ridge that runs northwest through Solomon Islands to Papua New Guinea. This ridge is the product of tectonic activity along the margin of the Pacific/Australian plate, and since it is an area of high heat flow and stress in the earth's crust the region experiences significant volcanic and seismic activity. A deep oceanic trench lies to the west of the archipelago which reaches depths of over 7,000 m off the island of Aneityum to the south and 9,000 m off the Torres Islands in the north (GoV, 1993; Weightman, 1989).

There are two distinct types of islands. The islands that lie at the centre of the archipelago, the hinge of the 'Y', are older than the other islands of the archipelago. The four oldest islands, Espiritu Santo (late Oligocene), Malakula (middle Miocene), Maewa (Late Miocene) and Pentecost (early Pliocene) are characterised by uplifted and eroded volcanic and sedimentary rocks, sometimes capped by a coral limestone which form mountain ranges rising to 700 m. Continued uplift during the Quaternary has produced extensive flat areas of reef limestone or limestone terraces on many of the larger islands. These limestone deposits are extensive compared to other Pacific islands, comprising about 60% of Efate, 90% of Pentecost and 40% on Santo. The limestone generally has a partial cover of ashfall from recent volcanic eruptions, or

deposits from geomorphological processes, which form a soil. The generally smaller, and younger islands, which form the arms of the 'Y' date from the late Pliocene. These are typical young volcanic islands whose cone and crater shapes are relatively intact. Three occupied islands, Ambrym, Gaua and Tanna, have active volcanoes. Widespread airborne deposits over time have deposited high fertility soils over most of the younger islands (GoV, 1993; Weightman, 1989).

2.2 Climate

With the exception of the islands to the extreme south Vanuatu lies in the tropics, and the southeast trade winds predominate for most of the year. The typical temperature range is between 21^0 - 27^0 C, and the average humidity is between 75 - 80 per cent. November to April is considered to be the hot or rainy season, when the trade winds frequently give way to short calms, followed by north to northeasterly winds that bring heavy rain. The annual temperature, humidity and rainfall generally decrease from north to south, but on the high islands there are also local variations related to altitude and exposure to or shelter from the prevailing trade winds. For example, low altitude south west facing slopes may receive between 2,500 mm and 4,000 mm a year whilst leeward north western slopes may experience a distinct dry season and an annual rainfall of less than 2,000 mm a year. In contrast, the highland areas at altitudes above 500 m in the southern islands, and 200m in the northern islands, experience humid, often misty conditions all year round with rain frequently exceeding 5,000 mm a year. Cyclones are not uncommon during the period November to April, but the region can also experience occasional droughts (GoV, 1993; Weightman, 1989).

2.3 Soils

P Quantin of the Office de la Recherche Scientific et Technique d' Outre-Mer carried out a comprehensive survey over the period 1964 to 1970 and the results have been published in a series of 1/100,000 and 1/50,000 pedological maps. A correlation of the French classification with the Great Soil Groups has been included in the Vanuatu

Resources Information System (VANRIS) Handbook (Bellamy 1993). Because the islands of Vanuatu are of recent volcanic origin the soils are generally fertile. Those on the perhumid uplands and slopes are typically andic-ferrallitic and unsaturated andosols. On windward slopes flat areas of reef limestone or limestone terraces have eutrophic brown and ferrallitic soils, whilst on leeward slopes soils tend to be vertic brown and fersiallitic (Bellamy, 1993; Weightman, 1989).

2.4 Vegetation

About one third of the country is forested, another one third is covered with thicket formations, and about twenty percent is bare ground or under human settlements. Vegetation types, and the areas they occupy, are shown in Table 1. The typical climax vegetation of Vanuatu is a dense closed canopy bush with scattered patches of rain forest. In comparison to other tropical forests those of Vanuatu are comparatively sparse and lacking in biodiversity. The trees are generally small with few reaching over thirty metres. (Baldwin *et al,* 1993; Weightman, 1989).

Table 1: Vegetation cover of Vanuatu

Vegetation Type	Area (ha)	Percentage of land area
Midheight forest (20-30m)	205,307	16.73
Low forest (10-20m)	234,089	19.08
Woodland (<10m)	386.00	0.03
Thickets (3-8m)	433,941	35.37
Scrub (<3m)	45,018	3.67
Grassland	51,128	4.17
Swamp communities	2,261	0.18
Mangroves	2,519	0.21
Bare ground or human settlement	252,256	20.56
Land Area	1,226,905	100.00

Source: Baldwin *et al* (1993)

There is a strong association between the age of the soil, fertility and the pedoclimatic sequence. The vegetation on very young soils has little diversification. Lava flows are first colonised by *Imperata* and *Nephrolepis* and later develop an open canopy of *Casuarina* and *Trema,* while ash plains have canopy thickets of *Cyathea*, *Veitchia* and

Weinmania. The mountain regions of the larger islands have a closed forest of small leaved evergreen trees; *Weinmannia* and *Metrosideros spp* are the most common, with a thick undergrowth of ferns, pandanus, cane, bracken, orchids, epiphytic mosses, lichens and liverworts. On the windward slopes below 400 m the forests are composed of taller broad-leaved evergreens, the most common being *Kleinhovia hospita*, *Ficus spp*, *Hibiscus tiliacaeus*, *Antiaris toxicaria*, and *Endospermum medullosum*. The last two are commercially significant. The natural composition of these forests has been altered by centuries of shifting agriculture and itinerant food gathering which would have favoured the growth of species with edible fruit or nuts or other useful by-products (Baldwin *et al*, 1993; Weightman, 1989).

The drier leeward sides of the islands are generally covered with a semi-deciduous forest and savanna characterised by *Acacia spirorbis*, *Leucaena leucocephala* (an introduced species) and clumps of bamboo. The open grassland comprises fire species as a result of frequent clearing and burning for agriculture. The coastal zone has remnant specimens of *Barringtonia asiatica*, *Callophyllum inophyllum* and *Hernandia peltata* among old coconut groves, but this zone has been extensively modified during the past hundred years by agriculture, plantations and settlement which have now spread for several kilometres inland. Coconut plantations are widespread, particularly on the larger islands. Many of these plantations are used to graze cattle; fruit trees, such as mango, breadfruit or cocoa are also planted between the coconut palms. Today, food gardens are mainly found along the lower slopes of the forested hills. Exposed and rocky coasts, and old lava flows support *Casuarina equisetifolia*, and mangroves are found in the more sheltered muddy lagoons (Baldwin *et al*, 1993; Weightman, 1989).

2.5 Native fauna

In common with most islands, Vanuatu has a limited terrestrial fauna with a comparatively high endemism. The vertebrate fauna consists of:
12 species of bats (two endemic) which are the only indigenous mammals; 121 species of birds (seven endemic); 25 species of lizards (eight endemic); two species of

snake (both introduced); and one crocodile (*Crocodylus porosus*). The invertebrate fauna includes 80 butterflies (three endemic), 22 earthworms (11 endemic), 12 ants and termites (five endemic), 73 land snails (60 endemic) 700 mosses and over 900 plants (135 endemic). A complete inventory of insects and other invertebrates has not been attempted. Four species of marine turtle visit the islands and dugongs are found in sea grass meadows. Vanuatu has a rich marine fauna with over 290 species of coral and in excess of 460 species of shallow reef fish (GoV, 1993; Bregulla, 1992; Chambers and Bani, 1988; Darby, 1992).

2.6 Population

It is thought the population before contact with Europeans was several orders of magnitude greater than it is today. For example the population of Aneityum was 3,500 in 1850 but only 543 today. Erromango was reported to have a population of about 4,500 in the mid 1800s which fell to 500 by 1930, and has only risen to 1,245 today (MacClancy, 1980). Reasons given for the decline are the introduction of exotic diseases through the sandalwood trade, early settlers and missionaries, and the "recruitment" of labourers for the sugar and cotton plantations of Queensland and New Caledonia.

The population of Vanuatu virtually doubled in the period between the first national census (1967) and the last national census (1989), increasing from 77,988 to 142,944. Latest estimates indicate a population of about 170,000 (ADB, 1996) which indicates a population growth rate of 2.9%. Whilst the national population density is low, at 11.6 inhabitants per km^2, the population is distributed unevenly across the country. Several islands are uninhabited whilst some of the small islands have a population density of >100 inhabitants per km^2 (Tacconi and Bennett, 1993). The population remains predominantly rural (80%) but there are signs of urban drift (ADB, 1996).

The present population is mainly concentrated in the coastal areas; migration to the coast from inland areas was a feature of the colonial period as the French and English established trade posts, missions, schools and health facilities. Vanuatu is one of the

more culturally diverse countries of the world, with over a hundred language groups. This cultural diversity is the basis of a wide variety of land tenure systems (Chapter 3).

2.7 Land use planning

Over the past decade Australia has funded three programs to help the Government improve land use planning. The first was a Topographic Mapping Project that commenced in 1984. Under this project aerial photographs were obtained of the whole country in 1986 and all information was recorded in digital form using a Modular GIS Environment. Topographic maps were then produced at a scale of 1:50,000 and the staff of the Department of Lands were trained to update both these and the digital database (AusAID, 1994).

In 1990 the CSIRO Division of Tropical Crops and Pastures and the Queensland Department of Primary Industries were contracted by AusAID to undertake a forest resource survey. One outcome of the project was the development of the Vanuatu Resource Information System (VANRIS) which integrates spatially referenced information of the type, distribution and use of the natural resources, and the distribution of population for the entire country (McAlpine, 1992).

The third Australian funded project, the Land Use Planning Project, commenced in 1996. This project has established a Land Use Planning Office (LUPO) in the Ministry of National Resources' Department of Lands. The project will build on VANRIS and use it as a vehicle to collate national data and make it available to government and non-government agencies.

Land use planning will be a three tiered process, operating at national, provincial and local levels. The national LUPO will maintain VANRIS and produce national land use plans. Provinces will have a major role in resource use planning and use, and will have to produce provincial land use plans, determine development priorities and approve development applications. Provinces must consult the local council of chiefs

in making these decisions. At present the capability of provincial administrations is limited as they lack trained staff, equipment and funding. Communities will also develop and approve local land use plans. The land use project has placed considerable emphasis on assisting communities to understand the planning process and to develop land use plans (AusAID, 1996).

2.8 Land clearance

Like other developing countries Vanuatu will probably have to clear more land for agriculture if it is to feed its people. It is estimated the rate of land clearance necessary is 0.5 ha for each additional person. Vanuatu's population is doubling every 25 years, an annual increase of 6,000, this means that 3,000 ha of forested land must be cleared every year. Forestry operations provide roads making access to logged areas easier, and as the forests have an estimated rotation of 50 years it is highly likely that many of the logged areas will be cleared for agriculture before they have a chance to regenerate (Blakeney and Davies, 1995).

Although Vanuatu has some 438,000 ha of forests (mid height plus low forest) only 274,000 ha of this is classified as loggable, i.e. $< 30^0$ slope (Baldwin *et al,* 1993). At the present rate of population growth it is possible all potential commercial native forests could be cleared for agriculture in the next ninety years unless the government can persuade landowners to adopt different land use practices.

2.9 Environmental management and conservation

At present, Vanuatu does not have specific legislation for environmental management or for conservation of natural resources. The National Forest Policy Statement, issued in May 1997, gave notice that the Government intends to place greater emphasis on the environment and conservation by introducing an Environment Act, a Water Resources Act and implementing the National Parks Act (GoV, 1997). In the interim, some protection of areas of high conservation value is available through other Acts such as the Forestry Act, and it's associated regulations (Chapter 6).

2.10 The National Parks Act

The National Parks Act No 7 of 1993 was gazetted in 1995 and the Director of Forests was appointed as Chairman of the National Parks Board. Under this Act the government is able to:

- establish a National Parks Board,
- declare National Parks and Nature Reserves,
- prepare management plans for National Parks and Nature Reserves,
- establish local management committees, and
- establish a Conservation Fund.

The National Parks Board operates under the direction of the Minister responsible for environment and conservation (currently the Minister of Natural Resources). The Board can have up to nine members, which must include the Directors of Lands, Geology and Mines, Fisheries, the Principal Environment Officer and the Chairman of the Council of Chiefs. The Act extends protection to areas considered by the Board to be of ecological importance, provide wildlife habitat and natural beauty, and are of archaeological, scientific and environmental significance. Communities who wish to establish all or part of their custom land as protected or conservation areas can apply for recognition under the Act although few have yet done so.

3 Land tenure

Land tenure issues often have a significant impact on economic activities such as forestry, particularly in the Pacific where the majority of land remains under 'traditional', 'customary' or 'native' land tenure systems. The importance of land to the Melanesian peoples should not be underestimated; to most Melanesian societies land is everything, land is basic to an individual's identity. '*Land represents life itself, both materially and spiritually, a person with no land has no roots, no status, no power*' (Arutangai, 1987).

3.1 A historical overview

Vanuatu was populated by the ni-Vanuatu, a Melanesian people from Papua New Guinea from about 3000 years BP. They brought with them domesticated animals, staple vegetables such as taro, yams, manioc and bananas, and probably bamboo. They came in several waves and each group brought with them their distinctive language and customs. Before contact with the Western world, the peoples of Melanesia practiced shifting agriculture, a practice in which small areas of forest were partially cleared and used for cropping for a year or two before being abandoned and allowed to revert to bush fallow. When clearing forest it was not unusual for large trees to be left, as it was technically difficult to fell them.

As the rate of population growth was very low there was sufficient land to meet the needs of the pre-contact communities and allow the native forests to regenerate after disturbance (Crocombe 1995). The forests played an important role in the lives of the pre-contact societies; they provided food, fuel and non-timber products such as fibre for clothing and fishing nets, building materials, and medicines. (Barden. 1993; SPREP, 1993).

The current population of Vanuatu is about 170,000 (ADB, 1996) inhabiting 68 islands and speaking over 150 languages. Pre-contact, there was a wide variety of custom land tenure systems. Most of these systems were dynamic and changed over time to meet new socio-economic or political circumstances. 'Custom' was not a

legal system, which was set once and for all, but a system of attitudes and values that were differently expressed in different places at different, times (Arutangai, 1987).

3.2 The traditional systems of land tenure in Vanuatu

There were two common themes to traditional land ownership in Vanuatu. The first was that the interests of the group (clan or lineage) are more important than the rights of the individual. The second was that individuals were permitted access to a diverse range of resources, for example gardens, hunting grounds, building supplies and non-timber forest resources (Arutangai, 1987; Rodman, 1995).

Traditional land tenure systems seldom specify how an individual loses the right to land, only how he or she acquires it. In general, in Melanesia there was a widespread custom that any man acquired for himself and his close kin, long-term rights to any land he cleared from virgin forest. When such land was abandoned, it reverted to common land that could, in turn, be reclaimed by whoever cleared it again at a later date (Crocombe, 1995).

Individuals could gain access to land and residential rights through ties to different groups and there were many group laws over descent and marriage which could be matrilineal, patrilineal or a mixture of both. Different customs could apply in groups that lived in very close proximity to each other, and an individual could have rights to land owned by several groups.

An individual could lay claim to any land that was not currently in use; however the claim only became a right if use was allowed. The senior males of the claimant's hamlet or clan first made determinations of claims whether inheritance of land was matrilineal or patrilineal. If there was no disagreement the claim was then considered by the senior males of related clans or hamlets. Residents had more rights than non-residents. (Arutangai, 1987; Ward and Kingdon, 1995).

A major drawback of traditional land tenure systems is that they are not suited to a market economy. Although Vanuatu had a system of largely non-hereditary leaders similar to the Big Men of the Papua New Guinea and Solomon Islands, these leaders were not as powerful as their counterparts elsewhere in Melanesia. In Vanuatu ownership was not vested exclusively in one person or entity, there was no finality in rights of use, no secure title; the real power over land remained with the group, and as there were so many fetters on alienation there is very limited scope for negotiation (Rodman, 1995).

3.3 The colonial experience

Although there is common acceptance of the view that traditional land tenure rules still apply in most of the Pacific, the way 'customary' land is held has changed to a greater degree than is generally acknowledged. Two closely linked developments brought about this change; colonialism and the development of a market economy.

Vanuatu was 'discovered' by the Spanish explorer Quiros in 1606, and mapped by Cook in 1774, but it was the discovery that sandalwood (*Santalum austrocaledonicum*) grew in the islands that first led to European interest in Vanuatu. Extensive extraction began in the 1840s but the availability of sandalwood quickly declined, and by 1865 traders were willing to pay, generally in pigs and shells, for sandalwood (Tacconi and Bennett, 1993). This was not only start of trading in the archipelago, but also probably the first example of unsustainable harvesting of forest resources in Melanesia.

Britain and France jointly extended their authority over Vanuatu, without claiming territorial sovereignty or demanding the allegiance of the islanders. Both British and French missionaries and settlers followed the traders, and, by 1873, large estates had been established at the expense of native forests. The colonial powers did not recognise native land tenure as it had no 'system' and no widely accepted legal basis, even in a traditional sense (Larmoar, 1984). Land distributed by the colonial governments was never recognised as lawful by the local people, and the seeds of

future conflict were sown as the ni-Vanuatu believed that land sold to Europeans would revert to islander ownership when the purchaser left (Arutangai, 1987). Whilst the British did not allow settlers either to establish legal title to land or recruit native labour, the French had no such reservations. As the number of French settlers increased, so did pressure on France to annex the islands.

Conflict over land issues broke out between settlers and islanders and, in 1887, a combined British-French Naval Commission was created to maintain order. The Naval Commission had no authority to intervene in land disputes, the source of nearly all the tension between settlers and islanders. Poor markets, cyclones, and disease took toll of the early European settlers, and many sold out to the Compagnie Caledonienne des Nouvelles-Hebrides which, by 1905, claimed more than 55 per cent of the total land area of the archipelago (Rodman, 1995).

A Convention of 1906 attempted to resolve the land issue. The Convention formed a Joint Court, consisting of a British and French judge with a Spanish president to resolve land disputes. Most claims were registered by settlers, missionaries of different persuasion, plantation and trading companies. However, the court did not make a judgement for nearly 25 years. The inefficiency, vested nationalism, and legal obfuscation in the early years of the Court set the tone for subsequent problems over land tenure. The court established its own categories of land for its own administrative convenience. Although islanders could apply to have land registered, few did so, as it seemed unnecessary. In addition, registration required all other potential landholders to agree to the granting of title to an individual. This was clearly contrary to customary practice and very few islanders filed for title (Rodman, 1995).

Although colonialism brought with it different concepts of land ownership, Ward and Kingdon (1995) argue that the greatest change under colonialism was the shift from subsistence to a market economy amongst the ni-Vanuatu. This led to a change from cooperative or communal life, where the provision of labour and exchange of good are based on reciprocal obligations, to a system where labour is sold for wages, and

goods exchanged for money. In a market economy land is a commodity rather than a '*stage on which activities take place*'.

3.4 The impact of the Second World War and the growth of the independence movements

The Second World War was a boom time for Vanuatu as the American Armed Services established several military bases on the larger islands. The development of infrastructure, paid employment, being treated as equals by the servicemen, many of whom were black and the sheer wealth of the developed world made a lasting impression.

The British and French Condominium was not able to maintain the pace of development after the war and several indigenous resistance groups became established. Dissatisfaction over land was a common feature of all of them. By 1971 the Vanuatu Parti was dominant, particularly outside Santo, and a cornerstone of its policies was the return of all land to customary owners and immediate independence of the country.

3.5 Land tenure post independence

Independence finally came in 1980. Under the new Constitution all land, except for land the government acquired in the public interest, now belonged to the "*indigenous custom owners and their descendants*", and the "*rules of custom were to form the basis of ownership and use of land in the Republic*". Only "*indigenous citizens of the Republic who have acquired their land in accordance with a recognised system of land tenure shall have perpetual ownership of their land*", and "*Parliament, after consultation with the National Council of Chiefs, shall provide for the implementation of Articles 73, 74 and 75 in a national land law and may make different provisions for different categories of land, one of which shall be urban land*" (Vanuatu Constitution, 1979. Chapter 12, Articles 71 - 76). Unfortunately, no national land law has ever been passed (Ellum, 1995).

The decision to revert to the 'rules of custom' created as many problems as it solved. On the one hand, it removed overnight the inequity and injustice of the colonial years, but on the other it did not consider the pre-eminence of the state and the market. Moreover, traditional practices are only recorded in memory, and cannot be recorded with any certainty after a hiatus of over a century. Memory is a selective thing, and is distorted by self-interest. In traditional societies, memories relied upon for a record of customary laws are those of a few specialists who generally had the support of those of rank and power. They tended to remember more of the land rights of those higher on the social scale than those in the lower social classes (Arutangai, 1987).

One outcome of the new constitution is that it changed the traditional Melanesian Big Man system. Traditionally, Big Men rise to prominence by giving things to others and building up an intricate system of obligations. As their status grows so does their power and wealth. On their death, however, all that they have returns to the group or clan. The new constitution has entrenched ownership of land on the Big Men of the time and has thus disenfranchised the rest of the clan (Rodman, 1995). The new constitution has established the notion of customary chiefs, and a National Council of Chiefs to oversee customary land law. Under the Land Leases Act it is possible for customary landowners to lease their land for 75 year terms, but lessees do not readily accept their obligations to comply with village or clan laws with regard to customary use of resources in leaseholds (Mariasua, 1995).

Both the current Chairman of the National Council of Chiefs and legal experts agree that customary land ownership and sustainable development are not complementary because customary land tenure is not similar to leasehold with its clearly specified land uses (Ellum, 1995; Mariasua, 1995). The uncertainty over land tenure is a disincentive to investors considering an extensive or long-term activity, such as forestry, particularly the establishment of commercial plantations. Nevertheless, some investors have been able to negotiate workable leases with customary owners, a practice that is being encouraged by the Government.

4 Vanuatu's forest resources

This chapter will describe the forest resources of Vanuatu, emphasising their potential for the production of wood. Non-timber forest resources are discussed in Chapter 5.

4.1 Forest resource databases

Vanuatu has comprehensive and relatively up to date databases of its natural resources. In 1987 the Government of Vanuatu requested assistance from Australia in the preparation of a national forest resources inventory. Following consultations between the Governments of Australia, Vanuatu, and the Commonwealth Industrial and Scientific Organisation (CSIRO), it was decided the inventory should be broadly based to include socio-economic and land use data, as well as natural resource data so as to enable it to be used for planning beyond the forestry sector. A team from the Queensland and Vanuatu Departments of Forests (DoF) was contracted to produce the Forest Resource Information System (FRIS). The FRIS was developed at the same time, and is compatible with, the Vanuatu Resource Information System (VANRIS) and the topographic information collected under the Topographic Mapping Project (Chapter 1).

The FRIS, completed in 1992, is a computer database and processing system that holds all the data derived from a forest field survey. The survey was conducted in all types of forest on all islands, regardless of type or likely commercial viability. The data collected included an inventory of commercial timber stands, traditional forest products, and the use of non-wood forest resources such as nuts and fruit, medicines, social and cultural uses, and hunting. The methodology used was flexible, and can be used for more detailed surveys if required. FRIS is a planning and development tool for determining the sustainable use of the forest resources for both traditional village and commercial use. The system is capable of adapting to the addition of new data, changes to policy and guidelines and can provide estimations of commercial volumes for any species or island in the country. The system is only available in the Vanuatu DoF but it can be linked to the data held by VANRIS. (Baldwin *et al*, 1993).

VANRIS, completed in 1993, is also a computer database, which contains a natural resource inventory of Vanuatu, including data on the geology, landforms, altitude, soils, vegetation, climate, population, and land use. It covers the whole country and can be used for development and conservation planning at national, regional, island and village level and was designed to provide an operational planning tool to assist land use planners and resource agencies in the management of the country's natural resources (Bellamy, 1993; McAlpine, 1992).

VANRIS software includes a data base management system (FOXPRO 2) and a desktop mapping facility (MAPINFO). It consists of three interrelated components: a map base at 1:50,000 and 1:100,000 in which the natural resources have been mapped in Resource Mapping Units (RMU); a data base comprising a information of each RMU; and a computer interface which provides a facility for rapid manipulation and analysis of the map and database. It has been installed on computers in all major government agencies concerned with resource planning such as Forests, Agriculture, Land Survey, Environment and the National Planning Office (Baldwin *et al,* 1993; Bellamy, 1993; McAlpine, 1992).

4.2 Field survey methodology

The methodology used by Baldwin *et al* (1993) to compile the FRIS can be divided into three phases, preliminary work, field data collection, and development of timber volume equations.

4.2.1 Preliminary work

A set of good quality aerial photographs at a scale of about 1:30000 were taken in 1986. These aerial photographs were used to distinguish vegetation types and land use intensity. A total of 35 forest types, and another 32 vegetation types were identified. Many of the forest types were characterised as combinations, particularly areas used as gardens in the fairly recent past which had patches of thicket scattered throughout them. These areas could not be separately delineated on an inventory of

the scale of the FRIS, and, where such combinations occurred, the areas of forest within combination areas were estimated using a general reduction factor. Detailed descriptions of the vegetation types and the rationale behind the interpretation methodology can be found in the VANRIS handbook (Bellamy, 1993). The aerial photography interpretations were validated by low altitude inspections by both helicopter and fixed wing aircraft and by ground inspections.

The resultant vegetation and land use information was recorded on 1:50,000 maps in a computer database. These maps were then overlaid with geological (rock type), geomorphological (slope and landform), altitude and climatic data. The polygons produced by this exercise were adopted as RMUs, which were used as the basis for planning and stratification of the field survey (Baldwin *et al*, 1993).

4.2.2 Field survey

The field survey was restricted to areas classified as forest, i.e. vegetation exceeding 10 m in height. Areas of forest with high land use intensity, or on slopes over 30^0, were not sampled.

Individual islands or isolated island groups were treated as distinct units. Eleven such units were identified. Within each unit the forest was stratified for sampling into groups of RMU which have the same or essentially similar characteristics in terms of forest type, landform, geology and rainfall. 225 strata were identified. The number of strata on individual islands, or island groups, ranged from 43 on Espiritu Santo, to 6 on Ambrym. As the area of forest in each RMU was determined on the basis of its vegetation and the level of land use many RMUs had to be classified as a complex mixture of forest and thicket. Where this occurred a reduction factor was used to calculate the area of forest (Baldwin *et al*, 1993; Bellamy, 1993).

The field survey used a variable probability method similar to that used by the Queensland Forest Service. The basis of the procedure for field sampling was that as far as possible, at least one randomly selected RMU from each stratum within each

island was sampled. Within each selected RMU at least two randomly selected plots were assessed. Additional plots were sampled where variability was found to be high. Plots consisted of twenty measurement points along a line, usually in the form of a large 'U'. Ten points at 30 m intervals were sampled along the transect defined by a compass bearing, a 50 m right angle offset made, then a further 10 points located along the reverse bearing to the original. At each twenty points a sweep by a glass prism with a basal area factor of ten was made to determine which trees were in the plot. Each tree in a plot was measured and assessed. Information was also recorded on the plot as a whole, such as cyclone damage, human interference, loggability and non-timber plants was also collected (Baldwin *et al*, 1993).

4.2.3 Tree measurement

In each plot all trees with a dbh >10 cm were measured. The data recorded included:

- a six letter species code made up from the first three letters of the genus and species name e.g.Garuga floribunda = GARFLO;
- dbhob in 1 cm classes and slope and distance to tree if borderline through the prism;
- quality of the stem of the tree as either sawlog (over 4 m log), minimum (2.4 m to 4 m log) or useless (based on form not species);
- availability of the tree based on distance from stream or ocean, or terrain or garden; and
- assessment of forkiness of the tree.

Timber volume equations were largely developed from data gathered from logging operations, but some standing tree assessments were made for comparisons with these data. The results showed that the volume equations of the major commercial species fell into one of four groups. Because of the sometimes limited data on some species it was decided to limit the development of volume tables to these four groups rather than attempt to develop species tables (Baldwin *et al*, 1993).

4.3 Commercial forest resources

Forests, using the criterion of vegetation with a canopy height of over ten metres, cover approximately 35% of Vanuatu. The estimation of which forests and what proportion of an area has commercial potential must take account of other factors which affect safety, cost and environmental impact of logging such as slope, landform and soil errodibility.

The Vanuatu DoF does not permit logging on slopes $> 30^0$. Loggability is defined by the combination of parameters describing slope, landform and soil errodibility. For instance, a forest on a slope of 20 - 30 degrees and dissected landform has a loggability between 20% and 40% depending on soil erodability. Midheight forests on slopes $<30^0$ cover about 11% of the land area, and a similar area is covered by low forests (Table 2).

Table 2: Summary of forest areas in ha by region

Region	Land	Forest	Forest with slope <30%			Loggable
			Midheight	Low	Total	Forest
	(a)	(b)	(c)	(d)	(e)=(c+d)	(f)
Banks/Torres	88,666	43,232	20,032	7,763	27,795	13,800
Santo/Malo	424,645	162,320	47,282	44,853	92,135	31,700
Ambae/Maewo	70,956	18,018	13,436	442	13,878	9,000
Pentecost	49,490	10,204	2,377	5,656	8,033	100
Malakula	206,756	75,306	10,853	32,330	43,183	20,200
Ambrym	67,264	6,042	0	4,851	4,851	2,900
Paama	5,982	53	0	0	0	0
Epi	44,693	10,858	0	9,272	9,272	0
Shepherds	8,631	132	0	132	132	0
Efate	97,004	22,950	17,345	2,596	19,941	14,300
Tafea	162.818	89,184	26,676	28874	55,550	24,640
Total	1,226,905	438,299	138,001	136,769	274,770	116,640

Source: Baldwin *et al* (1993)

Of a total forest area of 438,000 ha with a volume of 12,120,000 m^3, only about 274,770 ha with a volume of 7,210,000 m^3 is loggable. The area of commercial forest, which was defined as areas of forest with >15 m^3/ha of commercial species, is only 116,640 ha with a volume of 1,139,000 m^3 (Baldwin *et al*, 1993). It should be

noted that this summary makes no allowance for buffer zones around areas of environmental significance such as rivers and streams. If all the forest area defined as loggable were to be exploited, the total area of forest that would be disturbed would be greater than that defined as loggable due to the construction of logging roads, snig tracks, and associated infrastructure. These estimates have been recalculated (Chapter 10).

The survey by Baldwin *et al* (1993) concentrated on forest resources that could be harvested by large-scale commercial logging. The survey did not take account of small scale commercial logging, and logging by local ni-Vanuatu using what are sometimes termed 'wokabaut sawmills'. These are chainsaws or circular saws fitted with guide rails which permit logs to be sawn into dimensioned planks and slabs which suitable for local consumption in house construction or for further processing and value adding, e.g. as furniture components. For this reason, it is probably more realistic to consider Vanuatu's forest resources on an island by island or regional basis.

Although little is known of the rates of growth of the native forest species of Vanuatu, estimation based on similar forests in the Asian Pacific region suggests that a 50 year cutting cycle based on some form of size selection may be reasonable. Using this as a benchmark a preliminary assessment of the maximum allowable cut for all species currently listed as commercial was in the order of 23,000 m^3 per annum (Baldwin *et al*, 1993). This volume was calculated as a percentage of the whole forest resource and includes some areas, such as small islands that may not carry enough total volume to be worth the cost of extraction, and some species that, although logged in other countries, are rarely logged in Vanuatu. Incoll (1994) revised the potential cut upward to over 50,000 m^3; the issues of annual cut and sustainability will be discussed in Chapter 10.

4.4 Distribution of forest resource

Although most of the islands of Vanuatu are, or were, forested, few have any real commercial potential. However, most islands have sufficient resources to meet the needs of the inhabitants. The following summary of the resources of the inhabited islands is derived from Baldwin *et al* (1993).

4.4.1 Torres Islands

Total Loggable Forest Area (<30^0)	4,300 ha
Main Commercial Species	*Bischofia javanica, Burckella obovata, Endospermum medullosum, Intsia bijuga, Myristica fatua, Pometia pinnata*
Total suitable for Commercial Logging	122,000 m^3

Although much of the volume is in relatively small size classes, and is made up of less desirable species such as *Myristica fatua* there is some potential for commercial exploitation. Small scale processing for local consumption should be sustainable.

4.4.2 Banks Islands

Total Loggable Forest Area (<30^0)	9,500 ha
Main Commercial Species	*Adenanthera pavonina, Bischofia javanica, Endospermum medullosum, Hernandia moerhoutiana, Myristica fatua, Pterocarpus indicus*
Total suitable for Commercial Logging	nil

Although there are some reasonable stands in the Banks group most of the forest has a loggable volume of less than 15 m^3/ha. The most common species with commercial

potential is *Myristica fatua*, which is not currently logged in Vanuatu. There is potential for small scale utilisation by local sawmills.

4.4.3 Espiritu Santo, Aore and Malo

Total Loggable Forest Area (<30^0)	31,700 ha
Main Commercial Species	*Agathis macrophylla, Endospermum medullosum, Antiaris toxicaria Castanospermum australe, Dysoxylum amooroides, Dracontomelon vitiense*
Total suitable for Commercial Logging	456,300 m^3

Aore and Malo have good volumes of *Dracontomelon vitiense* and other commercial species but not over a large area. It should be possible to use these resources by trans-shipping logs to the mills on Santo. There are significant volumes of kauri (*Agathis macrophylla)* and blackbean (*Castanospermum australe)* on the west coast of Santo but virtually all of this resource is on very steep and rugged terrain and is not loggable on a large scale. This resource is logged for a small mill in Luganville producing furniture and panelling for niche markets. There are good stands of blackbean in the Big Bay area but this has been declared a Conservation Area under the South Pacific Biodiversity Conservation Program (SPREP, 1993; Maturin, 1993).

Endospermum medullosum and *Antiaris toxicaria* are the two species most commonly logged in these islands. The reserves of these two species have been affected by past logging, conversion of land to extensive farming and traditional gardening on the extensive flat areas in the east of Santo. The impact of weed infestation and clearing of logged areas for farming means that there is little regeneration and the base resource is dwindling.

4.4.4 Ambae

Total Loggable Forest Area (<30^0)	6,900 ha
Main Commercial Species	*Bischofia javanica, Chissocheton spp Endospermum medullosum, Intsia bijuga, Myristica fatua, Syzygium spp,*
Total suitable for Commercial Logging	175,300 m^3

There are some very good stands of high volume forests on Ambae, particularly in the south-west. The most common species is *Syzygium* with specimens reaching >100 cm dbh. The island lacks infrastructure and a detailed appraisal would be necessary before commercial operations could be contemplated.

4.4.5 Maewo

Total Loggable Forest Area (<30^0)	2,100 ha
Main Commercial Species	*Adenanthera pavonina, Bischofia javanica, Garuga floribunda, Intsia bijuga, Pterocarpus indicus Syzygium spp,*
Total suitable for Commercial Logging	3,800 m^3

Most of the resource is in the north of the island and is small in size. It is only suitable for small-scale operations for local consumption.

4.4.6 Pentecost

Total Loggable Forest Area (<30^0)	100 ha
Main Commercial Species	*Bischofia javanica, Dracontomelon vitiense, Endospermum medullosum Dysoxylum amooroides, Myristica fatua*
Total suitable for Commercial Logging	500 m^3

Only very small quantities of loggable forest remain on Pentecost. Most of what remains is high volume forest but in areas where it is difficult to log. These areas are worthy of conservation. The shortage of forest has been recognised and a plantation program is under way.

4.4.7 Malakula

Total Loggable Forest Area (<30^0)	20,200 ha
Main Commercial Species	*Adenanthera pavonina, Antiaris toxicaria, Castanospermum australe Dracontomelon vitiense, Dysoxylum amooroides, Pterocarpus indicus,*
Total suitable for Commercial Logging	150,000 m^3

The most common commercial species is blackbean, generally found in the central west of the island. An area has been logged, but the operation failed because of the poor yield. The forests on Malakula are low yielding but the resource could probably sustain small scale logging operations.

4.4.8 Ambrym

Total Loggable Forest Area (<30^0)	2,900 ha
Main Commercial Species	*Bischofia javanica, Dracontomelon vitiense, Dysoxylum amooroides Endospermum medullosum, Pometia pinnata, Syzygium spp,*
Total suitable for Commercial Logging	82,800 m^3

Ambrym has some good stands of loggable commercial forests located in the west and north of the island. Logs could be transported to Efate for processing.

4.4.9 Efate

Total Loggable Forest Area (<30^0)	14,300 ha
Main Commercial Species	*Antiaris toxicaria, Bischofia javanica Dysoxylum amooroides, Endospermum medullosum, Myristica fatua, Pometia pinnata*
Total suitable for Commercial Logging	52,000 m^3

The reliability of the data for Efate is in some doubt as many areas have been logged, and significant land clearing for agriculture has occurred since the aerial photographs were taken. *Endospermum medullosum* that has been logged has been found to regenerate poorly and this species has probably been over exploited on Efate.

4.4.10 Erromango

Total Loggable Forest Area (<30^0)	17,300 ha
Main Commercial Species	*Agathis macrophylla, Bischofia javanica, Calophyllum neo-ebudicum, Pometia pinnata, Pterocarpus indicus, Syzygium spp*
Total suitable for Commercial Logging	48,600 m^3

In general much of the forest area of Erromango is either inaccessible or difficult to log because of slope and soil errodibility. The survey excluded previously logged areas but it is possible that these could regenerate and be loggable in the future. Applegate (1993) reported that Calophyllum forests do not have the same weed invasion problems and could probably be logged sustainably with careful management. The data for Erromango needs checking as an independent survey estimated the loggable forest could be as much as double the results obtained by the FRIS (Thistlewaite, 1996).

4.4.11 Tanna

Total Loggable Forest Area (<30^0)	7,300 ha
Main Commercial Species	*Bischofia javanica, Dysoxylum amooroides, Elaeocarpus spp, Myristica fatua, Pometia pinnata, Syzygium spp*
Total suitable for Commercial Logging	49,800 m^3

Although there are substantial forests still on Tanna they are already under threat from clearing for agriculture and logging is not recommended.

4.4.12 Aneityum

Total Loggable Forest Area (<30^0)	40 ha
Main Commercial Species	*Agathis macrophylla, Calophyllum neo-ebudicum, Syzygium spp*
Total suitable for Commercial Logging	nil

Accessible areas have been logged in the past and are not carrying sufficient volume to be considered commercial. Residents will have to manage the remaining resource carefully to ensure sustainability.

4.5 Sandalwood (*Santalum austrocaledonicum*)

Information on sandalwood was gathered during the forest survey. It was found that the pattern of occurrence and density, whilst linked to vegetation, soil and climate, is also closely linked to patterns of human exploitation over the past hundred or so years. Sandalwood is still common on Erromango but the resources on most islands were so scarce that the survey was not able to quantify them. There are about 90,000 sandalwood trees on Erromango, but that these are mainly in the smaller class sizes (<10 cm dbh). Whilst the survey method permitted a broad assessment of the quantity of the resource it could not assess the monetary value as this is linked to the

quality of the heartwood in the tree which in turn is related to the rate of growth and environmental factors.

4.6 Limitations to the Forest Resources Information System

Although the databases created by the VANRIS, FRIS and the national mapping program provide a useful tool for land use planning and forestry management it is important the Government, and its foreign advisers, recognise the limitations of these systems.

The national forest inventory was compiled from a broad forest sampling process at a national scale of assessment. Such an inventory provides estimates of commercial tree volumes of the limited number of tree species included in the sampling process and limited to specimens >40 cm dbh. The FRIS can point to where potential commercial stands of trees exist, and these data are probably adequate for planning purposes at the individual island level. The data are, however, unlikely to be sufficiently detailed to provide volume estimates for a specific logging concession.

Thistlewaite (1996) believes there are several limitations in the FRIS that must be considered "*before putting too rigid an interpretation on volume estimates, and particularly on estimates of sustainable yield*". The major limitations identified by Thistlewaite are listed below.

- The aerial photography used for the analysis of forest type, cover and land use was taken in 1986. Field checking has indicated that there have since been some major changes, particularly in areas of high population.
- The FRIS includes 35 forest types and 32 other vegetation types. Many forest types were determined as a combination of forest types, particularly where small forest remnants occurred in agricultural areas.
- A national forest inventory focused on forests and did not include vegetation such as thickets which, whilst not containing timber suitable for sawlogs, still contained large volumes of useful timber and firewood.

- The FRIS did not sample high land use areas, many of which contain patches of trees which are loggable, and which provide significant volumes of timber.
- As it is DoF policy not to permit logging on slopes >30%, trees growing on steeper slopes were not sampled or included in the inventory. There are many areas on slopes <30% which are not loggable, but there are many areas where ridge-top roading would allow access to forests growing on >30% slopes. The exclusion of all areas >30% slope also ignores the potential to log high value species such as kauri where helicopter logging may be economic.
- The mathematical equations used for volume estimations were based on tree diameter alone, producing one-way volume tables. This is questionable in Vanuatu, as the crown break of trees of the same species on similar site quality sites can be highly variable due to crown damage by cyclones. Two-way volume tables based on diameter and bole length would be more reliable.
- The volume equations for the ten major commercial species will require further refinement before they are used to provide an accurate timber volume assessment for the control of logging operations. The equations should not be used to predict the volume of any trees <40 cm dbh.
- Statistical analysis showed significant differences for tree species between islands but volume tables were not developed for individual islands.
- Although the FRIS did include an allowance for defect this is always a problem with tropical species, particularly in cyclone prone areas. The defect equations are bases on very small data sets.

4.7 Plantations

With a limited native forest resource the future of the forest sector probably lies in the establishment of plantations, but the history of plantations in Vanuatu is not encouraging.

4.7.1 Local supply plantations

The concept of Local Supply Plantations (LSPs) was introduced in 1974 with the objective of establishing small plantations throughout the country to meet local needs for sawn timber. Under the LSP program, customary landowners would enter into an agreement to allow the DoF to plant trees on their land. Technical advice and nursery stock was provided, free of charge, and the agreement allowed forestry officials to carry out any necessary forest management activities. The owners also agreed not to lease or to otherwise dispose of the land or the trees without the consent of the DoF. If the trees died, or were accidentally destroyed, they could be replaced. On harvesting, the owners would repay the government the costs of establishment, maintenance, and a reforestation fee from the proceeds of the harvested timber.

Two exotic tree species were used in LSPs, *Cordia alliodora* (a hardwood native to Central and northern South America), and *Pinus caribaea* (a tropical pine native to the Caribbean and Central America). By 1986 a total area of 1022 ha of Cordia and 45 ha of pine had been planted in 25 LSPs on 13 islands, the individual plantations varying in size from 4 to 130 ha. This included 100 ha of Cordia originally established on Pentecost as an Industrial Supply Plantation (see below) but subsequently reclassified as an LSP. The LSPs were deliberately dispersed to reduce possible losses from cyclone damage, to provide a local timber resource and to provide rural employment. Table 3 gives the location, size and volume estimates of timber in the LSPs (Oliver, 1992; Thistlewaite, 1996).

Table 3: Estimated sawlog volume of Cordia LSPs

Island	Plantation	Average age (yrs)	Area (ha)	Est. volume (m^3)	Comments
Moto Lava	Central	12	15.2	291	No easy access
	Valua	16	5	349	Below average stand
Vanua Lava	Leion Bay	13	97.8	9063	No easy access
Gaua	Mesuvut	15	25.3	2363	No access
Maewo	Naumumu	14	53.3	5499	Access possible
	Naone	14	45	3644	Accessible
Ambae	Narugu	10	26.5	2034	No easy access

	Wailebutaga	14	7.8	700	Accessible
Santo	Vanafo	12	102.1	12147	Accessible
	Beleroux	14	11.8	676	Good access
	Navota Farm	17	10	619	Accessible
Malakula	Vao	16	25	1197	Damaged by '92 cyclone
	Unua 1	14	61.1	5772	Fair weather access
	Unua 4	15	52.3	5789	Good growth
	Wiaru	12	26.8	2710	Accessible
	Hatbol	18	18.5	2065	Accessible
	SW Bay	14	50.5	3935	No access
Epi	Sakau Bay	17	26	765	No access
Efate	Lelepa	15	30.4	940	Accessible
	Epao	13	6	218	Fair weather access
Tanna	Lenekel	15	5	524	Accessible
Pentecoste	Loltong	16	70	2564	Near road
	Surkavian	13	100	4271	No easy access
Total				**68137**	

Source: Viji (1997)

Note: 1 Jenks (1992) extrapolated 1 Volumes from the 1991 inventory

2 The total area of 872,400 ha is less that earlier reported by Oliver (1992) and Thistlewaite (1996)

A Swedish consultant reviewed the LSP scheme in 1984; his report condemned the scheme. The major criticisms were: the LSPs were located too far from centres of population; thinning was unprofitable; Cordia is not naturally durable and was susceptible to attack from the root rot fungus *Phellinus noxius*; and that regeneration was so vigorous as to warrant classification as a noxious weed (Brown, 1997; Oliver, 1992; Thistlewaite, 1996). Planting of LSPs stopped in 1986 and they were placed on a care and maintenance basis. The Vanuatu Forest Service subsequently conducted its own review of the scheme in 1986, and hired a consultant to do another in 1991.

The major conclusions of these subsequent reviews were that:

- in retrospect, it was not sawn timber that was needed, but poles and firewood;
- as local people had not been consulted about the scheme initially and were not interested in the plantations, they had no interest in Cordia as a wood; they preferred indigenous species with which they were familiar, and
- the customary land owners saw no reason to plant exotic species when there were so many native species for which they had traditional knowledge on growth and use (Brown, 1997; Jenks, 1992; Oliver, 1992; Thistlewaite, 1996).

The LSP scheme has obviously been less than successful. The question is now what to do with the trees in the LSPs. The wood in many of the LSPs has no commercial value as it is too far from any potential market. The local people could not afford to buy the timber, and anyway they have no use for it as they can get what they need from the native forests at no cost. The problem of Cordia regeneration is so bad in some areas that the landowners are asking for all the Cordia to be removed and the destruction of the regeneration at government cost.

The best option is for the government to return the LSPs to the landowners foregoing any potential profit on a no-liability basis. The landowners could either log the LSP themselves using mini-mill operations, contract out the logging to a timber company (if one is interested) or enter into some form of joint venture. When logged, the DoF should encourage and assist the landowners to establish local species such as whitewood (*Endospermum medullosum*). However, after the failures of the LSP scheme, convincing landowners to try again may prove to be difficult.

If the landowners refuse to accept the LSPs the government may have to remove the trees and destroy the regeneration. This has been attempted at one site on Santo and it proved to be an expensive exercise. The cost could be recovered to some extent from the sale of the timber.

4.7.2 Industrial forestry plantations

A second plantation scheme, Industrial Forestry Plantations (IFP), was initiated in 1982. The IFP scheme was designed to produce high quality sawlogs for processing and export. The United Kingdom funded the establishment of an IFP on Pentecost, and New Zealand agreed to fund three IFPs, two on Erromango, and one on Aneityum.

The ISP on Pentecost was not a success. 100 ha of *Cordia alliodora* were planted in a remote location in difficult terrain. It was poorly maintained and suffered severely

from fungal attack. It was converted to a LSP in 1988, however it has no commercial value and its mean annual increment is close to zero.

The two plantations on Erromango were a 320 ha Cordia plantation at Ipota, and a 45 ha plantation of *Pinus caribaea* at Dillons Bay. The IFP on Aneityum was spread over three locations, 206 ha at Umetch, 389 ha at Uje and 251 ha at Port Patrick. On Erromango, Dillons Bay was converted to an LSP, but Cordia planting continued at Ipota at a rate of 180 ha over 16 years to a total of 2880 ha. Planting has now ceased and Ipota is on a care and maintenance basis (Brown, 1997; Oliver, 1992; Thistlewaite, 1996).

The New Zealand authorities reviewed their program in 1989 and concluded there should be no further planting on Aneityum as the island was too remote to make timber exports economic. These plantings are now the basis of a New Zealand funded Community Timber Project. This three-year project aimed to provide the Aneityum community with training in basic forestry operations in the areas of pine established as an IFP. It is unlikely the project will continue after cessation of New Zealand Government funding.

4.7.3 Espiritu Santo industrial forestry plantation

Several studies by consultants indicated that Santo offered the best opportunity for the establishing commercial plantations. Santo has the most suitable climate, topography and soils and plantations could be established within easy reach of existing or planned industry. Santo also has the necessary infrastructure to support large-scale operations. Shark Bay was identified as being suitable for a large-scale industrial plantation and nearly 6,000 ha were leased to the DoF. The EU agreed to fund a pilot project and established an administrative centre and associated infrastructure. Only 370 ha of the planned 525 ha had been planted when the pilot project officially ended in December 1994. The EU provided funding for care and maintenance of the trials and infrastructure for the following year (Thistlewaite, 1996).

4.7.4 Future plantation needs

The DoF believe Vanuatu needs to establish between 20,000 and 24,000 ha of plantation. The DoF does not have the resources to carry out reforestation itself, and it is government policy for this to be left to the private sector. So far, only one has been established. Melcoffee Sawmills have planted 250 ha of whitewood (*Endospermun medullosum*) on a 1600 ha site on Espiritu Santo. European interests have recently completed a feasibility study to plant 20,000 ha commencing with 5,000 ha leased from the DoF at Shark Bay, Santo. The concept is to plant whitewood, mahogany and some eucalypts for woodchips to provide an early cash flow. Nothing has eventuated from these studies to date (ADB, 1996; Thistlewaite, 1996).

5 Non-timber forest resources

There is growing recognition that natural forests have to be viewed as more than a source of timber. Cases have been documented where the value of non-timber value of forests may exceed the value of the timber values by a factor of 2 to 3 (Peters *et al*, 1989), or at least for the non-timber value to equal the timber value (D'Silva and Appanah, 1993). However, with the exception of bamboo and rattan, the marketing potential of non-timber products has not been fully realised by many economists and government planners (D'Silva and Appanah, 1993). The annual world market for medicines derived from plants used by indigenous people has been estimated at $US 43 billion, and the total value of world trade in non-wood products is estimated to be about $US 11 billion (Blakeney and Davies, 1995; Braatz, 1997; D'Silva and Appanah, 1993). This Chapter summarises the non-timber forest resources of Vanuatu.

5.1 The use of forest resources by traditional societies

In the past, most of the inhabitants of Vanuatu practiced shifting agriculture, a practice where the land is partly cleared, useful or valuable trees are generally left standing. The majority of the wood, foliage and undergrowth is cut and burned, the ash left in situ to enrich the soil. In shifting agriculture gardens are typically worked for 2 - 3 years then abandoned when fertility is lost. Abandoned gardens are left fallow but regeneration largely consists of secondary species and weeds. Fruit or nut producing trees are planted by shifting agriculturalists; these trees remain the property of the planter even after the gardens have been abandoned. The produce of the vegetable gardens is supplemented by food gathered from the surrounding forests (Olsson, 1991).

Communities in semi-permanent villages, including those in the coastal fringe, also use forest resources. The availability and the extent to which forest foods are used vary from one region to another. Food crops, and their relative importance, have remained unchanged for centuries. The main staples are either yams or taro,

supplemented by bananas and breadfruit (*Artocarpus alfilis*). Sugarcane, green vegetables, fruits, nuts and ferns supplement the staple crops. Hunting provides wildfowl, flying fox, and wild pigs, whilst freshwater prawns and eels are caught in rivers and streams (Anon, 1995; Maturis, 1992; Olsson, 1991; Peters. 1996; Weightman, 1989).

Many forest food resources were not used as part of the daily diet, as they often grow as single plants and it requires considerable work to gather sufficient for a meal. In addition, many contain toxins and require time consuming preparation and/or prolonged cooking. In more recent times there are indications that whilst the older men and women still appreciate such food the younger generations, particularly those near the larger towns, seem to be gradually abandoning the old ways. However, these food resources provide security against famine when cyclones or droughts destroy food gardens.

The number of different species of plants used by subsistence communities is very high. Maturin (1993) recorded 21 forest tree species with edible fruit or nuts; and another 12 with edible shoots, leaves or roots. Another 53 species have medicinal properties, 34 species are used in house building and another 11 provide fibre and thatch. A total of 34 species are used for the manufacture of canoes, weapons, utensils, ornaments etc, whilst 11 species provide dyes, glue or resin. Three species are used as a source of poison, three are used as live fencing, six provide preferred firewood, and 11 had spiritual or tambu (sacred) significance.

5.2 The economics of subsistence agriculture

There is growing recognition of the economic importance of non-wood forest products from a conservation and economic viewpoint (Taylor, 1996). Two recent studies have highlighted the economic value of the non-timber values of native forests to subsistence agriculturalists in Melanesia; one on Choiseul, Solomon Islands (Cassells, 1997), and another in the Big Bay area of Espiritu Santo (Maturin, 1993). The aims of these two studies were similar. Both communities were being pressured

by logging companies to enter into agreements to allow timber harvesting on their land, and external consultants were used to provide the communities with information they needed to make informed choices.

Whilst the Cassells study is the better documented, both followed a similar methodology. A log was kept of all food and other items used by family groups, defined as people who regularly eat together. The value of these items was then calculated by noting the price at the nearest market where a similar item could be obtained. When items had a lasting benefit, for example housing or a canoe, the values were spread over the probable life of the item. Although the two studies grouped items in somewhat different categories the results of the two studies were remarkably similar in monetary terms (Table 4).

Table 4: Subsistence values of non-timber forest resources per household per year

	Vanuatu $ Aust	Solomon Is $Aust
Gardens [1]	6,156	8,679
Animals + forest foods	1,478	452
Housing	900	305
Firewood and other wood items[2]	2,068	960
Medicines		122
Total	10,602	10,518

Source: Cassells, (1997), Maturin, (1993)

Notes 1 Includes fruit and nuts harvested from forests.
2 Includes items such as canoes, utensils, ornaments, weapons, resins, fibre, poisons.

The 41 ha site owned by the village of Kuku on Choiseul, Solomon Islands was calculated to contain 2,081 m^3 of timber for which the villagers were offered $Aust 9/$m^3$ which would give them a once only royalty payment of $Aust 18,792. Subsistence losses from logging the same area were calculated to have a present value of $Aust 176,613. The net loss suffered by the village was therefore $Aust 157,884 or $Aust 7,518 for each of the 21 households in the village (Cassells, 1997). Maturin (1993) also came to the conclusion that the value of unlogged forests of Big Bay on

Espiritu Santo in Vanuatu was higher than the value of the timber in them. Although he calculated the subsistence values of these forests he did not include an economic analysis of the timber value to support his hypothesis.

Both of these studies conclude that timber harvesting would have a negative impact from both an environmental and economic perspective. Whilst there are probably many who would challenge the methodology of Cassells and Maturin their assessment of the relative values of timber and non-timber resources to the local communities is similar to assessments made in Amazonia (Peters *et al*, 1989), and Indonesia (D'Silva and Appanah, 1993).

5.3 Commercial non-timber resources

Most non-timber forest products are used by subsistence communities but some, have, or have the potential to be of economic significance. The following summary has been compiled from several sources (Anon, 1995a and 1995b; Baldwin *et al*, 1993; Cassells, 1997; Hunter, 1996; Olsson, 1991; Peters, 1996; Rodman, 1995; Tang, 1997; Weightman, 1989).

5.3.1 Firewood

Most rural communities are totally reliant on firewood for cooking. Estimates of consumption in the Melanesian islands are of the order of 2.7m^3 per household per year. This is a major cash crop of many communities whose traditional lands are still forested.

5.3.2 Bamboo (*Bambusa spp*)

The distribution of bamboo is greatly influenced by man's activities. It is widely used for house construction, furniture, kitchen utensils, fencing and sundry other uses. Many bamboo products have commercial potential yet to be realised in Vanuatu.

5.3.3 Rattan (*Calamus spp)*

Calamus spp are found in forests on Espiritu Santo, Pentecost, Malakula, Erromango and Efate islands. Calamus grows naturally in forests above 200 m, particularly on basalt soils, however it readily colonises disturbed areas of forests after logging or agricultural activities. Traditionally, the ni-Vanuatu use rattan for pole bindings during house construction, to bind handtools and the various parts of canoes. A factory on Efate produces rattan furniture for the local market using imported *Calamus manan* canes from Singapore. This factory is reported to be trying to establish a local source of supply (Tan, 1991).

5.3.4 Pandanus (*Freycinetia spp)*

Pandanus is an important source of food in some Pacific islands either for its edible kernels or flowers, or for the fleshy fruit base of some of the cultivated varieties. Although it is not consumed regularly in Vanuatu it is an important emergency source of food and has several other uses. The leaves provide thatch for houses, are woven into mats and baskets, and used to lash house beams together.

5.3.5 Black palm (*Cyathea spp)*

Black palm is used for traditional carvings and these are widely used in hotels and other businesses catering for the tourist trade as examples of local cultural artefacts. The analysis of its distribution and abundance is incomplete, as it was not included in the FRIS until after several of the largest islands had been surveyed.

5.3.6 Fruit and nuts

There is a small local industry that bottles and packages fruit and nuts gathered from the forests for sale in Port Vila. Four varieties of nut, nangi (*Canarium indicum*), naveli (*Barringtonia edulis*), naus (*Spondias dulcis*) and nntapoa (*Terminalia*

catappa) are proving to be popular with both local residents and tourists. Another product which is also exported is powdered kava (*Piper methysticum*), a traditional narcotic beverage of the Pacific. Fruit, nuts and kava have the potential to become important cash crops for villagers.

5.3.7 Coconut (*Cocos nucifera)*

The coconut occupies a very important place in the lives of the people of the Pacific. Vanuatu has large coconut plantations, and copra is still an important export crop. Individual trees are planted in villages and forest gardens and the products are used in a variety of ways. The nut is eaten, used as animal food or sold. The shell is used for utensils and ornaments, and the leaves are used for thatching, weaving, baskets, brooms and brushes. Husk fibres are spun into cord, and the wood is used for a wide variety of purposes including house construction and furniture manufacture.

5.4 Tourism

Tourism, particularly eco-tourism, has the potential to be of commercial significance to communities who live in areas where there are examples of undisturbed forest, unpolluted waterways and beaches. There is a fledgling ecotourism industry on Santo, Pentecost and Efate. Other suitable areas exist but are yet to be developed.

5.5 Genetic resources

The islands of the South Pacific have several endemic species of plants and animals, and there is considerable genetic variation between species on different islands. The significance of the genetic resource has not been investigated but interest in these resources is being shown by pharmaceutical, agricultural and forest industries. A project funded by Australia to conserve the genetic resources of species that are valued as either commercial forest species or important from a community perspective commenced in 1997 (AusAID, 1995).

5.6 Carbon offsets

Under the Framework Convention on Climate Change (FCCC) countries can '*voluntarily work to avoid or sequester greenhouse gas emissions*'. Carbon offsets are activities taken to sequester atmospheric carbon as a compensation for the release of carbon into the atmosphere at another site. For example, a country could invest in plantations to avoid more expensive measures to control emissions from activities in their industrial sector. Where these measures are to be taken in one area or country as a compensation for emissions in another they are known as Activities Implemented Jointly (AIJ) (Stuart and Jones, 1995). Several large corporations based in the United States are reported to be interested in establishing AIJ plantations to compensate for their carbon emissions. Whilst such investigations are still in their infancy, AIJ could provide the necessary capital to establish plantations in developing countries.

6 The Vanuatu timber industry

6.1 A brief history of commercial operations

Commercial forestry operations in Vanuatu began in the 1840s when sandalwood was harvested for export, but the rate of harvest was not sustainable and availability quickly declined. This was the first example of unsustainable harvesting of forest resources in Melanesia (Tacconi and Bennett, 1993). Logging for other species commenced in the 1960s but volumes cut only started to become significant over the past decade (Table 5).

Table 5: Volume of logs cut annually (m^3) 1983 – 1996

Year	Log exports	Domestic processing	Total harvest
1983	4030	7987	12017
1984	27184	9293	36477
1985	22146	10795	32941
1986	6637	12962	19599
1987	23716	15521	39237
1988	5001	17899	22900
1989	15085	19923	35008
1990	nil	19276	19276
1991	nil	27336	27336
1992	nil	20355	20355
1993	4014	21084	25098
1994	nil	43847	43847
1995	nil	32986	32986
1996	nil	34850	40130[1]

Source: Wood (1991); Bule (1995) Andrewartha (1997)

Note 1 Includes production of small sawmills

In the late 1980s several overseas donor countries, particularly the United Kingdom, the European Common Market (later the European Union (EU)), Australia and New Zealand funded projects in the forestry sector. The involvement of these donor countries was a reaction to the initiation of logging in Papua New Guinea, Solomon Islands and Vanuatu, at rates that were thought to be unsustainable. There were also concerns that the royalties paid to landowners and the taxation received by governments, were far below true market values.

Fortunately for the ni-Vanuatu, the government was receptive to advice and took steps to regulate the industry. A ban on the export of logs was imposed in 1989. The ban was lifted briefly in 1993 but reimposed in 1994 to conserve forestry resources and to encourage value added processing industries.

According to DoF records 15 wood processors were licensed under the Forestry Act in 1994 with a combined quota of 226,000 m^3. This represents anything from three to nine times the estimated sustainable harvest depending which estimate is used (see Chapter 10). The actual cut is significantly below this (Table 5). The large discrepancy between the permitted and actual cut is due to the practice of the timber companies applying for unrealistic allocations to exclude competitors (ADB, 1996; Tacconi, 1995).

6.2 Current commercial sawmilling activities

Several commercial sawmills have been established, but some are apparently no longer working. Most commercial sawmill activity is based on Santo with two minor operations on Efate. Table 6 gives production figures of the licensed sawmills in 1996.

Table 6: Commercial sawmill production in 1996

Company	Island	Annual Quota ('000 m^3/yr)	1996 Production ('000 m^3)
Pacific Island Timber Trading	Efate	20	1.35
Melcoffee Sawmills	Santo	15	7.16
Santo Veneers	Santo	60	24.77
Santo Joinery	Santo	10	0.57
Cap Querios	Santo	10	nil
Parkland Industries	Erromango	20	nil
Erromango Lumber	Erromango	5	nil
Pacific Veneers	Malakula	30	nil
SK Logging	Efate	40	nil
Elgress Agra	Efate	5	1
Total		202	34.85

Source: Andrewartha (1997)

The three operations on Santo are very different in scale and product. Melcoffee is a small traditional sawmill that produces sawn timber mainly of whitewood (*Endospermum medullosum*) and some milkwood (*Antiaris toxicaria*) for export.

Santo Joinery is an innovative door and furniture manufacturing plant which kiln dries then reworks rough sawn flitches of high value cabinet woods cut by locally-owned mini-mills operating in remote areas on the west coast. Santo Joinery purchases the flitches on the spot for cash, paying well above the average royalty for premier quality timber, which it then barges to Luganville. The landowners are happy with this arrangement as they earn as much as they would from a larger foreign-owned logging operation that would extract a much larger (and probably unsustainable) volume of timber (Thistlewaite, 1996).

Santo Veneers is a subsidiary of Rimbunan Hijau, a large Malaysian milling company and has established a large sawmill and veneer plant in Luganville in 1995 at a cost of $US 20 million. This mill has the capacity to process 60,000 m^3/yr, which is the company's quota. The amount harvested in 1995 was 11,200 m^3 rising to 24,770m^3 in 1996, mostly of milkwood plus a limited quantity of other species such as whitewood and island teak (*Intsia bijuga*). The current licence limits are placing extreme pressure on the forest resources of Santo, which has about 50% of all Vanuatu's commercial timber. Thistlewaite (1996) estimates that if harvesting occurred at the level of the current quotas the forest resources of Santo would be exhausted in 14 years.

The establishment of the Santo Veneers mill is surprising given the limited size of Vanuatu's resources. The ADB (1996) speculates that "*the decision could be explained by a combination of factors, and that the company:*

- *Substantially overestimated the size of Vanuatu's forestry resources, assuming commercial yields would approach those that it obtains in Papua New Guinea and Solomon Islands;*
- *intends to harvest timber way in excess of the maximum sustainable yield (although it has not yet done so);*

- *intends to implement a substantial planting program (this has not been forthcoming); or*
- *plans to import logs from Papua New Guinea or Solomon Islands".*

6.3 Small-scale sawmilling

The government has encouraged the establishment of small sawmills. The small sawmills primarily aim to meet local demand and are capable of operating profitably in areas with limited commercial timber resources and infrastructure. There are two types of small sawmills operating in Vanuatu, chainsaw mini-mills and portable single or double bladed band saws. The DoF have begun to implement a system to licence small sawmills and requires them to submit a quarterly report of their operations. So far, Vanuatu is the only country in the region attempting to regulate the operations of small-scale sawmills (DoF 1996). An estimation of the number of small sawmills operating in Vanuatu and their rate of production is tabled below.

Table 7: Estimation of small sawmill activities in 1996

Province	Islands	Portable Mills	Chainsaw Mills	Estimated Annual Production (m^3)
Torba	Torres Banks		3	120
Sanma	Santo Malo	5	27	1,440
Penama	Pentecost Ambrym		6	300
Malampa	Malakula Ambrym	5	9	1,080
Shefa	Efate Shepherds	11	3	1,080
Tafea	Tanna Erromamgo	13	7	1,260
Total		34	55	5,280

Source: Andrewartha (1997)

7 The forestry sector and the economy

7.1 Economic overview

In the fifteen years since 1983 Vanuatu has experienced a growth of GDP averaging 3% pa. Within this period performance has been erratic, and the yearly figures have fluctuated substantially reflecting the impact of climate on agriculture, changes in the investment climate, and fluctuations in tourist numbers. The underlying growth rate has barely matched the growth in population (2.9%) and living standards have stagnated. As 80% of the population still live in rural areas in a mixed cash/subsistence sector with strong communal and cultural obligations the incorporation of new technology and economic change is unlikely to be rapid. The general level of education is low, there is a shortage of skilled workers, and in a society where modern business practices are alien, entrepreneurship is underdeveloped (ADB, 1996).

Vanuatu has a large current account deficit, e.g. in 1997 GDP was 27,679 million VT with imports totalling 9,813 million VT and exports amounting to only 3,601 million VT. There have been some minor structural changes in the economy in recent years. The share of agriculture has fallen from 26 to 23 %, and services from 67 to 64 %, whilst industry has risen from 7 to 13%. Within the agricultural sector the share of copra has fallen from 6.4 to 2.8%, and subsistence production has fallen from 9.7 to 7.6%, whilst the share of cattle has risen from 2.3 to 3.3%. Forestry has remained fairly constant at about 10% (ADB, 1996; EIU, 1997).

7.2 The forestry sector

Estimates of Vanuatu's national sustainable rate of logging range from 38,000 to 60,000 m^3 per annum depending on the assumptions used (DoF, 1996). The average commercial volumes of timber per hectare are very low at 10 to 25 m^3/ha compared to 30 to 80 m^3/ha for Solomon Islands or Papua New Guinea. At present, the industry is largely based on two species, white wood (*Endospermum medullosum*) and the milkwood (*Antiaris toxicaria*). Neither of these would regarded as high value species in either Solomon Islands or Papua New Guinea (ADB, 1996)

The sawmilling industry has been able to meet a growing domestic demand for timber and the volume of sawn timber exports have increased steadily over the past five years (Table 8).

Table 8: Growth of domestic consumption and export of sawn timber

Year	Total production m^3	Domestic Consumption m^3	exports m^3
1990	19276	17337	1939
1991	27336	25702	1634
1992	20355	18086	2269
1993	25098	24840	2598
1994	43847	38740	5107
1995	32986	28826	4160

Source: DoF (1996), Tacconi (1995)

The export of timber products is assuming increasing importance to Vanuatu's economy, and by 1995 it had grown to become Vanuatu's third largest export of produce after copra and beef (Table 9).

Table 9: Exports of logs and processed timber 1982 – 1993

Year	Logs (m^3)	FOB Value VT millions	Timber (m^3)	FOB Value VT millions	% Total exports
1982	135	0.68	637	22.27	2
1983	3393	18.51	507	12.84	2
1984	18965	142.35	196	5.08	5
1985	16977	124.26	446	12.22	7
1986	7039	43.63	820	18.91	6
1987	18373	0.19	908	18.31	14
1988	5173	47.1	1827	59.2	7
1989	10467	101.42	1950	101.23	13
1990	nil	0	1939	90.06	5
1991	nil	0	1674	86.02	5
1992	nil	0	2269	146.38	7
1993	4014	43.14	2598	224.39	13
1994	nil	0	5107	225.43	n/a
1995	nil	0	4160	233.93	n/a

Source: DoF (1996), Tacconi (1995)

Although the revenue collected from the forestry sector seems to be fairly small in monetary terms (Table 10), it is an important element of the domestic economy. The GoV has a very limited revenue base and raises most of its funds from a duty on imports.

Table 10: Royalties, reforestation and export duty on logs and timber

Year	Royalties VT millions	Reforestation Tax VT millions	Export duty on timber and logs Vt millions
1982	n/a	n/a	4.1
1983	n/a	2	6.2
1984	n/a	7.8	21.1
1985	n/a	9.9	9.2
1986	n/a	6	5.3
1987	n/a	10.5	17.3
1988	n/a	n/a	11.5
1989	n/a	7.5	17.3
1990	32	9.6	4.6
1991	17.4	5.2	4.2
1992	20.8	6.3	6.1
1993	32.8	9.8	20.4

Source: (Tacconi, 1995)

8 Legislation and administration of the forest sector

8.1 The Forestry Act

The principal legislation governing forestry is the *Forestry Act 1982*. This Act, plus Regulations, Schedules and Orders made under the Act, regulates the administration of forests, plantations agreements, a system of timber licences, conservation, protection from fire, the administration of the forestry fund and reforestation charges.

8.1.1 Administration of forests

Under the Act the Minister for Agriculture, Livestock, Forestry and Fisheries is *"responsible for the proper management and development of the forest resources of Vanuatu"* (Forestry Act Part II Sect 2 (1)) The Act allows for the formation of a forestry service as the Minister is able to *"delegate any of his powers and functions to any forest officer, or any officer holding office in the public service"* (Forestry Act. Part II. Sect 2 (2)).

8.1.2 Forest plantation agreements

The Act makes provision for the Government to enter into plantation agreements to assist landowners to plant trees. These agreements may stipulate the design and management plans of plantations, and require the landowners to enter into a covenant that prevents them leasing or otherwise disposing of the land or trees without the approval of the Minister. The agreements include provisions that permit government forestry officers to implement appropriate management strategies in the plantations. The Act requires that records should be kept of all moneys spent on establishment and management of the plantations, these are then to be deducted from the proceeds of the sale of timber when the plantation is harvested (Forestry Act. Part III. Sect 4 – 9.

8.1.3 Utilisation operations

The Act requires that ministerial approval must be obtained before any person can carry out utilisation operations. With the exception of customary landholders, no person is permitted to harvest timber without first obtaining a timber licence. An application for a timber licence must obtain written agreement from the landholders and these agreements must be in a language acceptable to all parties. In the case of a landowner who wishes to fell timber on his own land the Minister may grant an exemption if he considers that the extent of the operation will not affect the national interests (Forestry Act. Part IV. Sect 9 - 13). The Act also requires all wood processing plants to be certified and registered (Forestry Act. Part IV. Sect 19). Through this provision the government should be able to monitor the harvesting all types of timber, and the output of all timber products. The Act also has provisions to control the activities of portable sawmills, the only country in the Pacific to do so. The problem is that the DoF does not have sufficient staff on the ground to exercise the level of control required by the Act.

It is a condition of every timber licence that the applicant must deposit with the forest service a sum of money, or a bankers guarantee equal to not less than three months royalty and reforestation charges. The deposit is used to pay royalties to the landholders and to meet reforestation or other charges. The reforestation charge is calculated as a percentage of the market value at stump on the volume of timber cut or sold, the market value is set by the Minister. The monies are paid into a Forestry Fund run by the Treasury. Should a deposit becomes exhausted the licensee must deposit a like sum or the licence will be cancelled. The maximum period for a licence is ten years and licences are not transferable without the consent of the Minister (Forestry Act. Part IV. Sect 14).

8.1.4 Conservation

Part V of the Act places certain constraints on forestry operations, but this has been largely overtaken by the introduction of the National Parks Act 1993 (Chapter 1) and the Code of Logging Practice for Vanuatu, see below.

8.2 Legislative weaknesses

Although over 21 amendments have been made to the Forestry Act since 1982 it still needs revision if it is to be reflect current international best practice for forestry operations. The major weaknesses in the present Act, and some suggested changes are:

- The Act does not address the issue of sustainability. The present aim of the Act is "*to provide for the development and control of forestry operations and for purposes incidental thereto*" rather than to "ensure ecologically sustainable forest utilisation" or similar words.
- The Act should require the Minister to limit the annual supply of timber to an amount that is less than, or equal to the estimated sustainable yield.
- The Act does not take into account the non-timber values of forests. It is important these are considered when determining forest utilisation and management plans.
- The allocation of timber licences should be based on the assessed standing volume of commercial species, regenerative capacity of the forest and its rotation period.
- Applications for logging licences should be based on a forest management plan that is consistent with the Code of Logging Practice, other legislation and regulations. The plan must have the endorsement of the landowners.
- The Act should include provisions to regulate the specifications and quality of wood products, for both the domestic and export markets.

Some of these issues are being addressed through regulations such as the Code of Logging Practice and the issue of sustainability will be further discussed in Chapters 10 and 11. The

DoF has prepared substantial amendments to the Act and it is planned to table these in Parliament in the second half of 1998.

8.3 The Code of Logging Practice

8.3.1 The Regional Code of Practice

The communique of the 1994 South Pacific Forum included, inter alia:

"Pacific Island leaders were strongly concerned about the exploitation of tropical forests in the region... " and *"warmly welcomed agreement between the Prime Ministers of Australia, Fiji, New Zealand, Papua New Guinea, Solomon Islands and Vanuatu to work towards a common code of conduct on logging of indigenous forests to which companies operating in their countries will adhere"* (South Pacific Forum 1994).

The *Code of Conduct for Logging of Indigenous Forests in Selected South Pacific Countries* was issued in September 1995 and endorsed by the Twenty Sixth Forum (South Pacific Forum, 1995). The 'Regional Code' was designed to be used as the basis for national codes by individual Forum countries.

8.3.2 The Vanuatu Code of Logging Practice

The final draft of the Vanuatu code, produced with the assistance of the Australian funded Vanuatu's Sustainable Forest Utilisation Project, was issued in July 1995 (DoF, 1995). The aim of the Code is to:

"Set minimum standards which will allow forests to be harvested with minimum adverse impact. It balances the needs for protection of environmental values with safety and commercial considerations"

The Code of Logging Practice is legally binding on all parties involved in licensed logging operations in Vanuatu. It is a manual that describes management techniques for logging operations and includes chapters on:

- forest use planning,
- conservation of flora and fauna,
- appropriate silvicultural regimes,
- areas excluded from logging (buffer zone protection),
- harvest planning,
- construction works for logging (roads, log ponds, bridges, skid tracks etc),
- logging operations,
- log scaling,
- weather limitations on logging,
- bush and camp hygiene,
- stabilisation of logged areas, training,
- supervision of operations,
- equipment safety, and
- evaluation of logging operations.

The government, and some prominent non-government organisations, have organised workshops, seminars and training sessions on the Code for employees of the Forestry Service, industry and landholders. These activities, involving representatives from all three groups whenever possible, have been successful in raising awareness of all stakeholders of their rights and responsibilities.

8.4 Administration of the forest sector

8.4.1 The Department of Forests

The Vanuatu Forest Service was formed in 1971. Initially, it was a section within the Department of Agriculture, but in recognition of the potential contribution to the country's

economy, and the role that forests play in the lives of the ni-Vanuatu, a Department of Forests (DoF) was established in the Ministry of Agriculture, Forestry and Fisheries in 1989.

The present organisational structure of the DoF is based on two operational divisions: Utilisation, Extension and Research, and an Administrative unit. Under this structure all field operations are managed from Port Vila and field staff are trained as either extension or utilisation officers. The larger centres generally have both extension and utilisation officers but for the smaller field posts a choice often has to be made whether to have an extension or a utilisation officer, and this is clearly not a satisfactory arrangement.

A new organisational structure has been designed on an area basis; the proposed structure is shown in Figure 1. In the new structure three regional offices will be established each responsible for two provinces, reporting to the Deputy Director. The regional staff will be cross trained so that field officers are able to provide both extension and utilisation advice. This will enable field officers to operate on a sub-area basis with an assigned group of landowners, which will strengthen coordination and ensure that landowners receive sufficient information and advice to enable them to make informed decisions.

A Technical Division, based in Port Vila, will be responsible for policy, strategic planning, research, promoting plantations and sustainable forest management. An extension specialist will develop landowner information programs, and a Forest Economic Marketing Unit will be established. The Technical Division will also manage a Forest Planning and a Research Unit. The Forest Planning Unit will be responsible for the work previously undertaken by the Conservation Unit and the Inventory Unit; this will provide dedicated resources to upgrade the FRIS. The Research Unit, located in Santo, will play an increasingly important role in the provision of growth and provenance information to potential plantation investors. The Administration Division will remain in Port Vila (Bowden, 1997).

The new structure was under consideration by the Government of Vanuatu in late 1997, but formal approval will not be forthcoming until the new Government settles in following the 1998 elections. In the interim, most of the reorganisation can proceed under departmental arrangements, as there are few resource implications.

8.4.2 Department of Forests financing

Most of the DoF's recurrent funding is appropriated by the Government from general revenue. However, the DoF also draws on the Forestry Fund. Salaries and wages comprise over 60% of the recurrent budget and only some VT 6 million is available for operations. This is clearly not sufficient in a country where forestry operations are scattered over several islands and air travel is frequently required. The income from the Forestry Fund is therefore crucial for the DoF's operations. The budget allocation, funds drawn from the forestry fund and total expenditure are tabled below.

Table 11: DoF Income and expenditure (VT millions)

	Income		Expenditure		
Year	Budget allocation	Forestry Fund	Salaries & Wages	Operational Funds	Total Expenditure
1990	22.0	3.1	14.4	7.1	24.6
1991	25.4	6.2	15.1	9.4	30.8
1992	27.6	6.4	16.1	11.0	33.4
1993	23.9	10.0	17.2	6.0	33.2
1994	23.3	9.0	12.0	7.0	28
1995	33.0	n/a	14.6	6.5	n/a

Source: (Thistlewaite, 1996)

There is some doubt as to whether the use of the Forestry Fund for this purpose is strictly legal. Section 27 (3) of the Forestry Act states that the fund *"shall be used for*

(a) the establishment and maintenance of forest plantations under forest production agreements;

(b) *other afforestation and reforestation works*".

There are no existing forest plantation agreements so the use of the Forestry Fund to help pay the DoF operational costs is based on an interpretation of the phrase "*other afforestation and reforestation works*".

The DoF has access to other sources of revenue. Annual Timber Licence Fees were introduced in 1993. The present fee structure is VT 2.5 million for a new licence, and an annual fee of VT 1.5 million irrespective of the size of the annual timber allocation. If all licence holders paid this fee it would net the DoF in excess of VT 18 million a year, but some of the licensees with small allocations pay a reduced fee, or may even be granted an exemption. In addition, the DoF collects a reforestation tax that is equal to 30% of the royalty; this is a substantial income. For example, the 1995 cut was estimated to be 60,000 m^3, using an average royalty of VT 1000/m^3 the reforestation tax would be would be VT 18 million. It is possible, therefore, for the DoF to earn something of the order of VT 45 million in licence fees, reforestation tax and new licence application charges. This gives the DoF the prospect of being fully self-funding. At present those of the above monies, which are collected, are held by Treasury and released to the DoF on request. Some of these funds are quite large and are likely to be used for other than forestry purposes.

9 Government policy initiatives for the forestry sector

9.1 Vanuatu's Third Five-Year Development Plan

The national objectives for the forest sector were included in the first national development plan (1982). These were included, without amendment, in the second plan and although the current, Third Five Year Development Plan, does not specifically include objectives for the forestry sector it implies that the objectives of the earlier plan are still valid. If this is the case, the national objectives for the forest sector are:

For Vanuatu to:

- *"become self-sufficient, where economic, in supplying domestic requirements of sawn timber and other forest products;*
- *develop a surplus of forest products for export;*
- *encourage the increased participation of ni-Vanuatu in sector programs;*
- *exploit forest resources more efficiently and institute a program for the long-term management of these resources for present and future generations; and*
- *investigate and, if feasible, develop the use of forest resources as an alternative energy source"* (Bule, 1991 and 1995; Wood, 1991).

It is understood that the Government is working on a fourth five-year development plan, but the recent change of government, and a proposed major reorganisation of the public service have delayed this.

9.2 National Forest Policy

The National Forestry Policy (NFP), issued in May 1997, builds on the earlier policy statements on forestry included in the series of National Development Plans and the Broad Forestry Policy Statement endorsed by the Council of Ministers in 1994. The NFP was prepared over a two year period with funding support from the UNDP, and technical support from the Pacific Islands Forests and Trees Support Program, a collaborative program of AusAID, UNDP, FAO and the South Pacific Commission.

The NFP incorporates feedback from a series of public workshops held around Vanuatu in early 1997 to discuss the forest policy and has broad community and industry support (GoV, 1997).

The NFP aims to provide a clear statement of the Government's forest policies to guide the work of the DoF, and to provide clear signals to both investors and donors on how forestry will be managed in Vanuatu. The NFP will also serve as a background document for a review of the Forestry Act. The NFP gives notice that the Government is placing greater emphasis on environmental management and conservation. The Government intends to introduce an Environment Act and a Water Resources Act, and plans to enact the National Parks Act (GoV, 1997).

9.3 Objectives of the National Forest Policy

The national goal for the forest sector is:

> *"to ensure the sustainable management of Vanuatu's forests to achieve greater social and economic benefits for current and future generations"* (GoV, 1997).

The development of sustainable forest management in Vanuatu must take account of land tenure issues. The government does not own any forested land, and under the Constitution it is an inalienable right of landowners to manage their land as they see fit. Whilst Government cannot directly manage forests it can regulate the forest industry through a system of licences, the provision of incentives for good management, and the establishment of an administrative system that will facilitate sustainable forest management. The Government also provides information, education and training. Mindful of the constraints under which it must operate the Government's objectives for the forest sector are to:

- manage the nation's forest resources sustainably as a renewable asset,
- identify forest land best suited for timber production, conservation and conversion,
- improve the knowledge of timber resources and other values,

- utilise natural forests in a manner which causes the least disturbance to the environment and conserves ecosystems, and
- improve the management of sandalwood and encourage the development of sandalwood industries (GoV, 1997).

9.4 Roles and responsibilities

There are several stakeholders in the Vanuatu forest sector; the roles and responsibilities of the principal players are outlined below.

9.4.1 National Government

The national Government is responsible for forest policy and determining how the national forest resources should be managed. The national Government is also responsible for the enactment of forestry legislation, the issue of licences for harvesting and processing enterprises, and for the provision of adequate resources to implement and manage the NFP.

9.4.2 Department of Forests

The DoF is responsible to the Minister for the implementation of the NFP and the Forestry Act, and to promote the sustainable management of forest resources. The DoF also provides advice on forest conservation and the management of protected areas and National Parks. The DoF is the focal point for liaison with customary chiefs, Provincial Governments and other National Government agencies such as the Department of Lands, including the Environmental Unit, and the Department of Agriculture. The DoF is responsible for ensuring that the requirements of the Code of Logging Practice (Chapter 6) are incorporated in all utilisation operation agreements. The DoF must assess annual logging plans before issuing timber licences, and is responsible for monitoring forestry operations. The DoF is also responsible for the collection of data, the conduct of research, and to facilitate the development of commercial plantations and agroforestry systems.

9.4.3 Provincial Governments

The role of Provincial Governments is to assist with the development and implementation of provincial land use plans, and to assist the development of forest industries, plantations and supporting infrastructure. Provincial Governments assist with the resolution of disputes over land, and facilitate the protection of conservation areas identified by landowners. They are also assisting the DoF in providing advice to communities, and monitoring forestry operations.

9.4.4 Customary Chiefs

The main role of the customary chiefs is to maintain traditional social structures. They are a focal point for the DoF in discussions with communities on logging plans, the identification of tabu sites, and the resolution of disputes.

9.4.5 Landowners and communities

Landowners, in consultation with communities, have the power to decide ultimately how their forest resources are to be managed. They will be assisted by the DoF to monitor forest operations, to ensure that the provisions of the Code of Logging Practice are followed, monitor forest utilisation agreements and reforestation programs. Landowners are permitted to harvest their own trees using mobile sawmills.

9.4.6 The forest industry

Under the NFP, industry will be responsible for the preparation of logging plans and management strategies in accordance with the Forestry Act and the Code of Logging Practice, and for the development of a skilled rural workforce. Industry has to negotiate timber harvesting and plantation development with landowners and to liaise with national and provincial governments in developing infrastructure. Industry is encouraged to develop value-added timber processing facilities that meet international standards and to find markets for Vanuatu timber products. Industry is also

responsible for financing reforestation and plantation development and to cooperate with the DoF in research on forests and forest products.

9.5 Policies and strategies

As the Government has little direct control over land management it has identified several policy initiatives and strategies to meet the objectives of the NFP.

9.5.1 Land use planning and forest classification

In consultation with all stakeholders the Government will develop land use planning processes with the aim of producing land use plans at national, regional and local levels. The value of non-timber forest products and the environmental value of forests will be considered in the classification of forests. The aim is to identify areas which are best suited for long term forest production, areas of forest that should be protected, and areas that are suitable for conversion into other land uses.

9.5.2 Better management of forestry operations

The Code of Logging Practice, which sets minimum standards for the conduct of forestry operations, will be phased in over three years. All operations will have to comply with the Code by the end of the year 2000. The DoF, in conjunction with landowners, will undertake compliance and monitoring.

9.5.3 Improved forest inventories

The DoF will establish standards for forest inventories and will systematically improve the database on the forest resources of Vanuatu. Landowners and industry workers will be provided with training in forest inventory techniques and all timber licence holders will be required to undertake forest inventories prior to harvesting. The DoF will review the FRIS every ten years.

9.5.4 Sustainable yield

The Government will legislate to ensure that the amount of timber harvested from native forests in any five-year period does not exceed the estimated sustainable yield. This limit was set at 61,900 m^3/yr in 1996 but the limit will be recalculated every ten years. If necessary, the annual allocations of timber licences will be adjusted, or, if appropriate, additional licences issued.

9.5.5 Management plans

The DoF will prepare strategic forest management plans at the national and regional level. All timber licensees will be required to prepare annual strategic harvesting plans and detailed coupe-harvesting plans in accordance with the Code of Logging Practice.

9.5.6 Timber licences

Licences are required for any commercial timber utilisation operation. Licences will be issued for a period of five years for mobile sawmills and ten years for companies with large timber processing plants. Licences are not transferable.

The Government will introduce a ten-year 'evergreen' licence, which can be renewed every five years to companies that demonstrate a commitment to sustainable forest management and value added processing. These companies will have to enter into a Memorandum of Understanding with the Government.

9.5.7 Utilisation licences

Any person who cuts timber on land that they do not own requires a Utilisation Licence. This will include the operators of mobile sawmills. The DoF will ensure that agreement has been reached with the landowners prior to issuing a licence.

9.5.8 Reforestation

The Government will encourage natural reforestation of forests after logging and will require timber licensees to ensure regeneration in designated production forests. Priority will be given to protecting natural regeneration during logging operations. Reforestation tax rebates will be paid to companies and landowners who can demonstrate adequate management of reforestation after logging.

9.5.9 Non-timber forest products

The use of non-timber products should be allowed to continue on a sustainable basis.

9.6 The forest industry

The Government will maintain the general ban on the export of logs and flitches and plans to create an environment that will attract investment and foster the development of internationally competitive forest industries which are committed to sustainable management. Priority will be given to high technology, capital intensive, value-adding proposals, based, where possible, on plantations established by the private sector. The Government will facilitate ni-Vanuatu participation through investment in the forest sector particularly through joint ventures (GoV, 1997).

The Government's objectives for the forest industry are to develop an industry that will:

- utilise the nations forest resources to provide economic and employment growth,
- increase timber processing facilities to meet domestic timber needs and to increase value added processing,
- develop efficient and internationally competitive forest industries,
- increase employment opportunities and develop a highly skilled ni-Vanuatu work force for the forest sector,
- expand export capacity for value added timber products, and
- control and support the development of mobile sawmills (GoV, 1997).

The Government will encourage domestic processing by mobile sawmills and plans to allocate 30% of the available forest resource to such mills. Whilst this may sound a high proportion, mobile mills can operate economically in locations where the size of the resource is too small for conventional commercial operations.

9.7 Revenue raising and administration

Government policy is that by the end of the year 2000 the DoF must generate sufficient revenue to fund the cost of Government activities in the forest sector, and to return a surplus by the year 2005.

Timber licensees will have to pay holding fees, a timber licence fee, forest management charges and a mill registration fee. The holding fee is paid to landowners for each area under a utilisation agreement whether logging takes place or not. In addition, the Government will establish minimum royalties that must be paid to landowners for each species of log harvested. Timber licence fees are related to the maximum volume permitted under the licence. All new licences for more than $500m^3$ will have to pay a licence fee, (this will include many mobile mills).

The present reforestation charge will be replaced by a forest management charge equivalent to 50% of the log royalty. A system of rebates will apply where adequate reforestation or plantation establishment programs are implemented.

In addition, all companies in Vanuatu have to pay an annual business licence fee and export duties (Table 12) where applicable. These fees and duties will be set at a level to maintain an equitable distribution of revenue between the Government and landowners.

The Forestry Fund will be maintained but the use of this fund will be extended to cover the operating costs of the DoF to fund forestry training and international forestry cooperation. A portion of forestry revenue will be paid to provincial governments or Councils of Chiefs *"in recognition for the utilisation of local resources and to facilitate their involvement in supporting the forest sector"* (GoV,

1997). The intention of the Government is that these payments are for use in supporting forestry activities and for local infrastructure. Payments will require an agreement that specifies the level of involvement in forest management and the scale of forest operations in the area.

Table 12: Proposed export fees for timber products, logs and flitches

Product	Export Duty % of FOB price
Sawn timber <200 mm thick	5%
Veneer <6 mm thick	3%
Joinery timber and products planed on 4 sides	3%
Finished furniture	1%
Logs and flitches	
FOB 0 – 70 ($US/m^3)	75%
FOB >70 – 110 ($US/m^3)	50%
FOB >110 ($US/m^3)	15%

Source: GoV (1997)

9.8 Afforestation and extension

9.8.1 Plantations

Plantations will be promoted as a means of ensuring a reliable long-term source of wood for the timber industry. The aim is for 20,000 ha of commercial plantations to be established over the next 25 years. The selection of sites will be based on land capability, landowner support, development of infrastructure and proximity to shipping facilities (GoV, 1997). Obtaining landowner support may be a major stumbling block given the experience of the two earlier plantation schemes (see Chapter 4).

Holders of 'evergreen' renewable licences will have to establish and maintain at least 5 ha of commercial plantation for each 1,000 m^3 of timber harvested. Fast growing native species will be encouraged for use in plantations, but exotics may be used where they have shown to grow well in local conditions. Plantations larger than 50 ha

which are managed under an approved management plan, will be subject to a different set of harvesting conditions and fees.

The government will attempt to develop markets for the present LSPs, those LSPs with no commercial potential will be returned to the landowners.

9.8.2 Extension

The DoF extension programs will focus on sustainable management, and tree planting programs. The extension program will support tree planting by landowners and community groups and will target areas where landowners have shown an interest in forest operations, areas where there is a shortage of forest products and areas of high conservation value. Agroforestry and silvipastoral systems will be encouraged. The DoF will continue to operate nurseries and will encourage the development of private and community nurseries.

9.9 Environment and conservation

Whilst recognising that Government Policy must be "*tempered by the fact that it is an inalienable right of landowners under the Constitution to manage their land as they see fit*", the Government's environment and conservation objectives are to:

- protect and conserve biological, germplasm, cultural, historical and other non-timber forest values for the benefit of present and future generations;
- establish and manage conservation areas with landowner participation;
- identify potential environmental impacts before new timber licences are issued;
- encourage communities to minimise soil erosion and to rehabilitate existing eroded areas; and
- conserve mangrove ecosystems and restrict any non-sustainable uses of them (GoV, 1997).

The Government intends to develop an Environment Act, a Water Resources Act and to implement the National Parks Act (Chapter 1). Other Government initiatives include an undertaking to conduct a national biodiversity survey to identify sites that are important for biodiversity conservation; to work with landowners to establish

conservation areas, and introduce regulations to ensure that there is an environmental impact assessment before any licences are issued for major forestry operations. Future forestry operations must be undertaken in accordance with the National Water Resources legislation to protect catchments, and the Government will work with communities to promote soil conservation and to rehabilitate severely eroded areas.

9.10 Research, education and training

9.10.1 Research

The DoF will undertake research in consultation with industry and other stakeholders. Priorities for the next five years are:

- a continuation of the plantation trials,
- silviculture of native species,
- natural regeneration,
- vine control measures,
- seed gathering and nursery techniques,
- tree improvement and the preservation of genetic resources,
- the promotion of agroforestry, and
- erosion control and site rehabilitation.

The DoF will collaborate with overseas institutions and international agencies and will encourage the private sector to do research.

9.10.2 Education and training

The Government will encourage the provision of technical forestry training, both in country and overseas, to ensure there are sufficient numbers of qualified foresters to implement the policy of sustainable forest management. The DoF will facilitate training of industry workers and landowners to increase the skill base of the forest sector.

10 Calculating the allowable cut

10.1 A model for the sustainable management of natural tropical forests

The basis for sustainable management of natural forests is a cutting cycle that will maximise timber production whilst ensuring that no deterioration occurs in the prospects for future harvests. This must be calculated from an inventory of the standing stock and an estimation of the length of the cutting cycle, the period between successive loggings, that leave enough stems on the ground of acceptable species, form, health and free of damage to grow as the next crop (Poore *et al*, 1989).

The system that is commonly used in South East Asia is the Indonesian Selective Logging System, *Tebang Pilik Indonesia* (TBI). TBI is based on three variables:

- the cutting cycle,
- the minimum number of trees in a stand after harvest, and
- the minimum size dbh for trees that may be harvested.

The challenge to forest managers is to determine harvest levels that will leave a residual stocking distribution which will provide sustainable yields, this is referred to the 'steady state' (Ingram, 1996). The problem is that a forest exists in a variety of conditions, the challenge is how to convert a forest to the steady state. Determination of subsequent cutting cycles is further complicated as the quantity of the first cut will probably not be matched by future cuts unless the forest is closed for a considerable period, Poore *et al* (1989) suggested >100 years.

Ingram (1996) measured tree growth in Indonesian, Malaysian and Philippine forests and using the assumption that commercial tree species, i.e. those with a dbh between 20 and 50 cm, grow at 1 cm dbh per year modelled three cutting cycles, 35, 45 and 55 years. She estimated that the period of conversion of a forest to a steady state would take 4 to 5 cutting cycles, a period of 175 – 220 years. Her conclusions were that only the 55 year cutting cycle gave positive soil rents and an acceptable internal rate of return.

Ingram's conclusions are similar to those of Poore *et al* (1989) who believed that it would take at least three cutting cycles of between 35 and 60 years to be confident that forests were being managed sustainably.

10.2 The present rate of logging

To date, the DoF has issued 15 commercial logging licenses for a total annual harvest of over 226,000 m^3. A ban on the export of logs was imposed in 1989 which although lifted briefly in 1993 was reimposed later that year to conserve forestry resources and to encourage value added processing industries. A proposal to permit the export of logs was passed by Cabinet in 1997 but the legality of this was challenged and the issue was placed in abeyance pending the outcome of 1998 elections. The new Government has indicated that it will not lift the ban.

The actual cut has been significantly below the permitted cut, (Table 5). The large discrepancy between the permitted and actual cut is due to the practice of the timber companies applying for unrealistic allocations to exclude competitors (ADB, 1996; Tacconi, 1995).

10.3 First attempt to calculate a sustainable cut

One of the aims of the Forest Resource Survey Project was to determine a sustainable level of commercial logging given the paramount needs of the local communities. The assumptions used by the project team in estimating the allowable cut were that:

- timber on slopes $>30^0$ is inaccessible,
- not all timber on slopes $<30^0$ is available due to dissected landforms and unstable soils,
- timber volumes less than 15 m^3/ha are not economic, and
- growth data for similar ecotypes in Papua New Guinea and Australia suggests that sustainable logging requires a 50-year cutting cycle.

The FRIS and VANRIS were interrogated using these assumptions and the standing volume of timber available for logging was determined to be 1.139 million m^3. Based on a 50 year cutting cycle the annual rate of logging that could be sustained was therefore 22,780 m^3 ($1.139x10^6$ divided by 50) (Baldwin *et al*, 1993).

10.4 A reassessment of the yield

Incoll (1994) made a reassessment of the sustained yield. Incoll believed that Baldwin *et al* had used too broad a definition of sustainability. In the preface to his report Incoll stresses that the definition of sustainability depends on how the word is used, for example:

- **Ecological sustainability** – "*essentially means the conservation of biodiversity. In the context of Vanuatu, the most important element of this is the protection of the wide range of flora and fauna that are essential for the continued success of the subsistence economy of rural communities*".
- **Sustained yield forest management** – "*is the management of a forest estate so that it produces a sustained yield over the long term future (several hundred years). Sustained yield forest management is not the same as ecological sustainability; it only refers to the small subset of biodiversity represented by trees that are used for timber production*".
- **Sustainable yield** – "*is the timber volume that can be cut from the forest on a long term basis without depleting the total timber resource. In other words, harvest volume must be less that the total growth of timber in the forest*" (Incoll, 1994).

In common with other commentators on the forest sector (Chapter 11), he then uses his own definition. In the introduction to his report he accepts that "*perpetuating the forest is the essential first step both in attaining sustainable yield for forestry and ecological sustainability*". He then asserts that "*sustainability in the broad sense is the long term conservation of the forest as a forest*". The problem that some may have with this definition is that "*the long term conservation of a forest as a forest*" does not of necessarily imply the preservation of the biodiversity of the forest. The management of forestry operations under such a model could result in the elimination

of one or more commercial species, as their replacement by other tree species would still meet the definition of a forest.

To achieve his broad definition of sustainability Incoll believes that:

- *"The primary aim must be to control logging activities so that important local impacts like damage to soil and water quality, are minimised and the forests are regenerated.*
- *The secondary aim should be to control the cut on a national basis to a level at which total demands on the forest (including subsistence and small scale commercial, as well as industrial needs) do not result in reduced production of the national resource. The cut must be kept to a level at which DoF resources can meet the primary aim".*

Incoll based his revised estimate on two groups of species, those that are currently logged and sold in Vanuatu, which he termed *Vanmerch* species, and those that are generally accepted as commercial species in the Pacific area, *Pacmerch* species. The Pacmerch group of species includes all of the Vanmerch species. The forest resources of individual islands were grouped to calculate the volume available on a regional basis and updated volume tables, which were derived from a larger sample than the previous tables, were used for the calculations. He then refined the area that could be logged, and the volume that would be available using the following nine assumptions.

- Areas where the slope was $>30^0$ were excluded.
- Slope, landform and soil erodibility factors were applied in two steps. The first was to determine the effect of landform and slope; the second to estimate the additional effect of precautions to prevent soil erosion. His reasoning for this was that whilst the effects of landform and slope are fixed, soil erosion can be reduced by suitable prescriptions during forestry operations.
- Two minimum yields were used, 10 and 15 m^3/ha.
- Islands with a total volume of less than 5,000 m^3 were excluded, as volumes below this would not be economic.

- Allowance was made for the area of land that would be required to meet the subsistence needs of a population growing by 2.8%/yr. Based on the work of Weightman (1989) an allowance of 0.5 ha/person was made.
- Any islands where the increase of agricultural land needed to meet population growth would be equal to, or greater than, the calculated loggable area of existing forests were excluded, i.e. Tanna, Ambae, Pentecost, Maewo, Ambrym and Aore.
- The available volume of timber was reduced to exclude species that bear fruit and nuts used by subsistence communities.
- A reduction was made to allow for the protection of streams and beach frontages. The protection strips were 10 m from streams and 40 m from beaches.
- No adjustments were made for national parks or conservation reserves.
- No adjustments were made for areas that had been logged since 1986 the date of the most recent air photography on which all maps are based. This was based on the assumption that logged areas were regenerating and were therefore still available for future forest operations.

10.5 Estimation of the cutting cycle

Baldwin *et al* (1993) used a 50-year cutting cycle for their calculations as they considered this to be an appropriate estimation based on information of growth rates in regional forests.

In Papua New Guinea, growth rates of 1 to 1.5 cm dbh per year have been recorded in trial plots. This could produce increments of 0.5 to 2.0 m^3/ha/yr which, if combined with a well controlled selective logging program, could lead to a return period of 30 to 40 years (Cameron and Vigus, 1994). In Solomon Islands, measurement of growth in a series of plots over a 21 year period suggests that the return period could be 40 years, but this would have to be extended to 50 years for stands damaged by cyclones (Solomon Islands Government, 1993).

No long-term research on growth has yet been done in Vanuatu. A study which measured average diameter distributions, an alternative method to estimate the return period, indicated that, even though about 30% of immature trees were damaged during logging operations, that the present stocking rate of 30 – 50 stems per ha of

commercial species of trees would be sufficient for a return period of 40 years (Applegate, 1992). Applegate found that most commercial species were regenerating naturally with the exception of whitewood (*Endospermum medullosum*).

The forests of Vanuatu are frequently damaged by cyclones. An opening in the canopy caused by either logging or cyclones encourages the growth of climbers and vines that are a threat to regeneration. The commercially important *Endospermum medullosum,* which is thought to be primarily a pioneer species (Wheatley, 1992), is particularly threatened by the vines *Merremia pltata* and *Mikania sp.*

10.6 Results of the reassessment

After allowing for the volume of timber in all of the restricted areas only about 20% of the total forest resource is available for logging (Table 13).

Table 13: The effect of restrictions on the use of forest area on the volume of timber available and the impact on the annual sustainable yield.

Steps in calculating the available resource	Volume available			
	Vanmerch spp '000m^3		Pacmerch spp '000m^3	
Total volume in all forests	9351		12883	
Less				
Volume on slopes >30^0	2897		4032	
Unsuitable landforms	3621		4960	
Reduction for soil protection	73		95	
Available resource	2760		3796	
Minimum economic yield	10m^3	15m^3	10m^3	15m^3
Delete				
Uneconomic yield/ha	2656	2495	3727	3640
Islands with < 5000m3	2639	2478	3710	3624
Land needed for population increase	2244	2098	3036	2979
Volume of fruit and nut spp	2037	1910	2731	2676
Volume in stream buffer zones	1921	1887	2585	2638
Sustainable annual yield	38.4	37.7	51.7	52.7

Source: Incoll (1994).

Table 13 clearly shows that the two factors that significantly reduce the volume of timber available for logging are unsuitable landforms (39%) and slopes $>30^0$ (31%). These limits are almost universal, as conventional logging equipment is not able to operate safely on slopes above 30^0. Whilst in some countries techniques such as the use of helicopters and cable systems are used to recover high value logs these techniques are unlikely to be economic in Vanuatu.

Using 15 m^3/ha as the minimum economic yield Incoll calculated that a sustainable volume of the Vanmerch species currently being harvested was 38,000 m^3/yr but that this could rise to 51,700 m^3/yr if all the Pacmerch species were harvested. He assessed that these volumes could be cut from the forests of Vanuatu on a long-term basis without reducing the total stock provided that an appropriate management regime was established, and that regeneration was assured. The natural forests of Vanuatu could not, however, meet local needs and supply the approximately 50,000 to 70,000 m^3 necessary to sustain an economic export logging operation. The two conditions attached to Incoll's estimations are probably the Achilles heel of the forestry sector in Vanuatu. At the time of his review Incoll noted that logging was not under control and that regeneration was not reliable leaving him with the conclusion that "*regardless of the cut, forestry in Vanuatu was not sustainable*".

10.7 Adjustment of the yield

In 1996 the DoF had adjusted the sustainable yield upward to 61,900 m^3/yr. This adjustment was made on three grounds. The first was to include the islands having less than 5,000 m^3 of Pacmerch timber as it was asserted that although Incoll's estimations were realistic in normal circumstances, in Vanuatu any assessable timber could be logged by small sawmills either for local consumption or for sale to the larger processing facilities. The second consideration was that timber in small residual pockets in predominantly agricultural land could be harvested. The third consideration was not to use 10 m^3/ha as an economic limit as the smaller sawmills, particularly the mobile sawmills operating in the small islands, could operate profitably below this limit. Table 14 gives the revised sustainable estimate by island.

Table 14: Adjusted sustainable yield by island.

Island	Total Volume Pacmerch spp ("000m^3)	Commercial Volume ('000m^3)	Incoll's estimation of sustained yield[1] (m^3/yr)	Adjusted sustained yield[2] (m^3/yr)
Banks/Torres	1,875	487	9,700	9,700
Santo/Malo	5,079	1,197	23,900	30,000
Ambae/Maewo	818	0	0	3,500
Pentecost	325	0	0	1,200
Malakula	1,635	328	6,500	5,500
Ambrym	214	0	0	1,000
Epi	3	0	0	0
Efate	479	271	5,400	5,000
Erromango[3]	2,455	302	6,000	6,000
Total	**12,883**	**2,585**	**51,700**	**61,500**

Source: Thistlewaite (1996)

Notes: **1** Incoll's data for a minimum economic yield of 10m^3/ha
2 Figures rounded up
3 Data for Erromango is considered suspect
4 All calculations assume a 50 year cutting cycle

11 Sustainable forestry – a theoretical perspective

The concept of sustainability is now a cornerstone of economic development and the management of natural resources, including forestry. Commercial forestry has a long history and the concept of a sustained yield is ingrained in traditional forestry training and practice. It is the basis for managing forests so as to produce a continuous supply of wood whilst safeguarding the productive capability of the forest. Sustained yield focuses on the technical aspects of forest management; whereby for each forest unit an allowable cut is calculated which is designed to ensure that future productivity of the forest is maintained in perpetuity. Sustainable forestry, however, relates to the forest sector as a whole, including other economic activities based on forest resources (Gane, 1992). It not only refers to the conservation of forests to providing a continuous flow of timber, it also includes their non-wood products as well as the forest's environmental, biodiversity and genetic values (ITTO. 1992). In relation to development, sustainability aims to "*find a path of economic progress which does not impair the welfare of future generations*" (Pearce *et al.* 1989).

Before investigating options for sustainable forestry Gane (1992) believes that it is necessary to find the answers to two questions:

- what is to be sustained? and
- how can sustainability be achieved?

The answer to the 'what' question depends on the local situation, desired outputs, commodities (wood and non-wood), conservation aims, environmental impacts, economic factors, beneficiaries etc. "*Sustainable forestry therefore depends on finding a satisfactory combination of sustainable elements, based on the particular situation and problems being addressed*". The 'how' question involves "*seeking a satisfactory balance between resources and uses having regard to both space and time differences. Sustainability requires a reconciliation of supply and demand*" (Gane, 1992).

It is important that planning in the forest sector must be dynamic, pragmatic and flexible, as the impact of activities in other sectors may upset the sustainability of the forest sector, such as changes in the market, or clearing for agriculture. The task of preparing long-range projections is probably impossible without the employment of computer modelling (Gane, 1992).

11.1 Defining sustainability

Poore *et al* (1989) believe that sustainability is an ambiguous concept, and that it is generally expressed in relation to specific products or benefits derived from any particular forest. It is no surprise, therefore, that the definitions in the literature of sustainable forest management vary. To most foresters it is something akin to "*the controlled and regulated harvest of timber species in natural forests, combined with the use of various silvicultural and protective measures to sustain or increase the commercial value of forest stands that return after the initial logging*" (Schmidt, 1987 in Johnson and Cabarle, 1993). A somewhat different approach is taken by the International Tropical Timbers Organisation (ITTO) Council which believes that sustainable management is "*the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment*" (ITTO, 1992). The ITTO definition is significant as it recognises non-timber products, biodiversity, environmental and social values.

11.2 A review of tropical forestry operations

Johnson and Cabarle (1993) undertook a review of recent forestry literature on sustainable management of tropical forests their findings are summarised in Table 15. Johnson and Cabarle concluded that, whilst there is a rough consensus that sustainable management of natural forests is technically feasible, even the most experienced foresters admit that good examples are hard to find. However, doubts still remain in many quarters as to whether commercial timber production in native forests can be compatible with the preservation of biodiversity, indigenous cultures and the wide range of environmental benefits that are attributed to intact forests.

11.3 Issues effecting sustainability

The review of forestry operations summarised in Table 15 raises several common issues that are said to effect sustainability, these are discussed below.

11.3.1 Lack of a common definition

As noted earlier, there appears to be no agreement over exactly what is meant by sustainability. For example the definitions cited in Table 15 range from *"sustained yield of timber (based on natural regeneration)"* Hartshom (1990), to *"forests must be used economically in a way that yields a high production of valuable products in the long perspective, retains fauna, and protects the global and local environment"* Johnson and Lindgren (1993). The differences in definition will obviously influence the evidence cited for sustainability, perceived constraints to sustainable management and conclusions reached by the various authors on forestry operations.

11.3.2 Evidence for sustainability

Although all of the authors surveyed by Johnson and Cabarle (1993) provided examples, most of the evidence cited was circumstantial, often based on examples of 'abundant' or 'successful' natural regeneration following the first harvest. Land conversion, over-exploitation, institutional or economic instability mar many of the examples cited before conclusive evidence of sustainability has become available. In other cases the existence of a management plan based on the principles of sustained yield is considered to be evidence that a forestry project is sustainable. This lack of conclusive evidence led Poore *et al* (1989) to conclude, *"it is not yet possible to demonstrate conclusively that any natural tropical forest anywhere has been successfully managed for the sustained production of timber"*.

Issues	Wyatt-Smith (1987)	Schmidt (1987)	Poore et al (1989)	Goodland et al (1990)	ITTO/HIID (1988)
Definition of Sustainable Forest Management	Forest exploitation that provides a regular yields of forest produce without destroying or radically altering the composition and structure of the forest as a whole	Controlled harvesting combined with silvicultural practices to sustain or increase value of subsequent stands all relying on natural regeneration.	Forest use in which nothing is done to irreversibly reduce the potential of the forest to produce marketable timber.	Use of natural forest that indefinitely maintains the forest substantially unimpaired both in environmental services and in biological quality.	Multiple use management of forests for sustained yield of timber is emphasised.
Evidence to support sustainability	Abundant natural regeneration; regeneration of preferred species; successful natural regeneration.	Successful regeneration; liberation thinning in selectively logged forests to produce a new good quality stand quickly; selective logging leaving a commercial residual stand.	Sustainability cannot be proven until after the third rotation.	Sustainability cannot be proven until after the third rotation at minimum. Colonial regimes in Asia and Africa approached sustainability.	Polycyclic systems with liberation thinning show promise.
Major achievements (economic, political institutional, social)	Some successful management programmes developed in Malaysia and Philippines.	Some success with systems in lowland dipterocarp forests in Sarawak and Philippines.	Sustainable production of tropical timber is negligible.	The colonial systems yielded about 2.5 to 5m^3/ha/year.	Forest systems have shown some success (technically) in Sarawak and Africa
Major constraints (economic, political institutional, social)	Overexploitation and logging damage shortage of trained staff and funding desirable species must be present with abundant natural regeneration, management systems may be site specific.	Landless poor occupy many cut over sites; liberation thinning requires adequate stock and manpower; short-term horizon of policy makers; low proportion of commercially valuable species; need for flexible silvicultural regime.	Land use policy; financial policy; forest legislation; illegal clearing; over exploitation	Forests overexploited; population pressures; institutional instability; sustainability expensive to maintain and produces low rate of return.	Economic, social and institutional rather than technical. Pressure to reduce felling cycles, unwillingness to invest, undervaluation of forest resources
Conclusions about prospects for sustainability	Tropical forests can be managed sustainably+B12, but plans must be suited for local conditions.	Asian experience shows that it is technical feasible.	Technically possible for many forest types, but current practice is negligible.	Sustainability of tropical hardwood production has not been achieved, would not be profitable were it to be enforced, and is unlikely to be achieved in future.	Technically feasible, and examples do exist; most forests receive little or no silvicultural treatment and no protection.
Recommendations	Flexible management plans; take local conditions into account; take a long term view; promote welfare and participation of local people.	Flexible systems to match variability and complexity of tropical forests; commitment by national leadership; training, legislation and planning.	Government resolve and long term security; landuse plans; standards for allowable cut; cutting cycles; harvesting techniques, etc.	Government commitment and system of incentives; selective extractions; deflect logging to secondary forests.	Silvicultural data and analysis; socio economic and institutional data and analysis to develop management plans.

Table 15 continued

Issues	Jonsson & Lindgren (1990)	Keto et al (1990)	Perl et al (1991)	Hartshorn (1990)	Bruenig and Poker (1989)
Definition of Sustainable Forest Management	Forests must be used economically in a way that yields high production of valuable products in the long term retains fauna and protects the global and local environment.	Sustainable cut is equivalent to the volume of incremental growth between harvests; definition should include maintaining biodiversity.	The natural tropical forests must be managed to provide economic benefits without destroying the long term productive capacity.	Sustained yield of timber (based on natural regeneration)	Wise use of tropical rainforests for long-term economic and ecological benefits.
Evidence to support sustainability	Abundant regeneration after harvest; regulations in Queensland which recognise long-term economic and environmental considerations.	The Queensland model, which has been promoted as sustainable, is based on a depauperate database and thus inappropriate as a model.	None of the examples from Latin America are demonstrably successful in all the necessary elements of sustainable forest management - all need more time.	Natural regeneration on two demonstration strips has been very good (1,500 individuals, 132 species, over 50 cm after 15 months)	Malaysia has achieved sustained yield; indications for sustainable forestry in Congo; TSI project in Philippines residual diprocarp forests successful.
Major achievements (economic, political institutional, social)	Good planning and careful logging has led to sustainable use in Costa Rica and Queensland.	None mentioned.	Forests a permanent rather than a short-term resource; economic gain for local communities; provide land rights to native peoples.	Forests will give a sustained yield; provide employment for native communities; protect cultural intregrity of native peoples.	Several successful examples exist; income of inhabitants increased; environment stable.
Major constraints (economic, political institutional, social)	Pressure to reduce cutting cycle; natural forests cannot be completely protected within framework of commercial forestry.	Queensland timber industry was heavily subsidised; a 40 year cycle will lead to structural changes and a reduction in species diversity; sustaainability definition usually ignores biodiversity	Social pressures; lack of technical and financial resources; low stumpage value; government policies that impede forest management.	High cost of extracting wood; lack of understanding of tropical forests; government policy; need marketable building-phase species to grow in forest gaps.	Political conditions; laws; lack of attention to non-timber products; lack of technical training; lack of incentives to manage forests.
Conclusions about prospects for sustainability	Sustainable management can be achieved in most areas with proper planning, execution and control; inherent ecological mechanisms must not be irreversibly disturbed.	No valid reason for using the Qld model as the basis for sustainable timber production.	Natural forest management is Technically feasible (extraction of timber and non-timber products in ways that maintain forest structure and regeneration).	Palcazu project has potential for sustainable development; market acceptance of larger number of species will assist management.	Rainforests can be managed successfully.
Recommendations	Practical guidelines for cost effective and environmentally sound logging practices must be compiled and widely disseminated.	Restrict industrial forestry to less environmentally sensitive areas; large scale timber supplies should only come from plantations	Need for reform in policy; long-term consistent technical and financial support; ability to resolve political disputes and give benefits to local people.	Palcazu project could be duplicated.	Need adequate political support, involvement of local people, project integrated training programmes.

Source: Johnson and Cabarle, (1993)

11.3.3 Public Policies

Nearly all tropical countries allocate the rights to harvest timber through concession systems, more often than not, to overseas timber companies. Most concession systems used to allocate and regulate timber extraction are weak, and undervalue the stumpage value of tropical timbers. Most governments seem more interested in short term gains, and all too often fail to ensure that they obtain a fair return through royalties, taxes and rents from timber concessions with the result that the majority of profits go to the timber companies. Few, if any, concessions include any requirements for sustainable forest management; they are little more than licences for mining operations that severely deplete, and often destroy tropical forests. This is often attributable to a lack of capacity for effective policy, planning, supervision and monitoring in government institutions, but corruption in both government and industry is not uncommon.

Although some government policy is well intended, all too often forest policy has been adopted without considering the possible impacts of the policy on forests. Repetto (1988) has suggested six reasons why policies that lead to the degradation or destruction of forests are so widespread.

- The economic values of natural forests are undervalued by policy makers who limit their assessment to the value of timber and land that could be used for agriculture.
- The economic benefits of forest exploitation are overestimated and the costs ignored. Rotations are generally planned at less than the regeneration rate and the quality of marketable timber is often overestimated.
- Government agencies involved in planning and forest management lack the technical knowledge necessary to understand the potential and limitations of the resources they are responsible for managing.
- Governments believe they can use forest resources as a short-term solution to a wide range of economic, social and political problems.
- Few national governments are prepared to make the necessary investment to develop a viable and sustainable forestry industry.

- National governments do not recognise the value of traditional management practices and governance of forest resources.

11.3.4 The impact of logging

Most harvesting of tropical forests involves selective logging and only partial deforestation. The degree of deforestation differs from region to region, and with the target species. For example logging the dipterocarp forests of Asia may remove up to 40% of the standing timber volume which removes between 15 and 40 percent of the canopy cover (Bundestag, 1990). However, selective logging does damage unharvested growing stock including mechanical damage, gaps in the canopy increasing the vulnerability of remaining trees to windthrow, whilst nutrient loss, soil erosion, soil compaction, and diminished water retention capacity often has an adverse effect on regeneration (Johnson and Cabarle, 1993).

The impacts of logging can, however, be reduced to an acceptable level by the introduction and adherence to a strict code of conduct for logging operations such as that recently introduced in the South Pacific (South Pacific Forum, 1995). Papua New Guinea, Solomon Islands, Vanuatu and Fiji have all introduced national codes of conduct based on code endorsed by the South Pacific Forum.

Selective logging also plays an important role in ultimate tropical deforestation, as it is often a catalyst to the conversion of forests to pastures or agricultural land. The infrastructure built for the logging operations provides relatively easy access to areas previously blocked by dense forests, and the removal of the largest trees makes the clearing what is left all that much easier.

11.4 A common criteria for sustainability

There is an obvious need for common criteria for sustainable forestry. The ITTO convened an expert panel to formulate general criteria for sustainable tropical forest management. The panel included representatives from producer and consumer countries, industry and non-government organisations. The Eleventh Session of the ITTO considered the expert panel's recommendations, and published a provisional list

of criteria and possible indicators for sustainability at both the national and forest management level (Table 16). The criteria were deliberately designed to be as simple as possible, field orientated, and to focus on current weaknesses in management. It was considered the criteria would provide a basis for forest management, and act as a standard reporting system to facilitate comparison and discussions (ITTO, 1992).

Table 16: Criteria and indicators for sustainable forestry (ITTO, 1992)

Criteria	Indicators
Sustainable at the National Level	
The forest resource base	Comprehensive land use planning and provision for the permanent forest estate
	Present area of the forest estate in relation to national goals and targets
	Plantation establishment targets, present age age class distributions, and annual planting regimes
	Areas of protection forests and production forests within the permanent forest estate
The continuity of flow	National production of forest products over time
	Documentation of logging history over time
	Proposed cutting cycle lengths for major forests types, and standard concession lengths
	Regulation of subsequent harvesting in relation to increment data and the net area of production forest
	Steps taken to harmonise the first and subsequent cutting cycles and manage the transition from first to the second cutting cycle
	Wood production targets over time from various sources
	The availability of silvicultural prescriptions for the major forest types

The level of environmental control	Management prescriptions for other non-production components of the permanent forest estate
	The availability of engineering, watershed protection and other environmental management prescriptions for production forests
	Availability of environmental assessment procedures
Socio-economic effects	Employment patterns and trends
	Income generation and distribution patterns
	National review and expenditure budgets for forest management
	Availability of environmental assessment procedures
Institutional frameworks	Existence of a national forest policy
	The relationship of national policy to ITTO Guidelines
	Adequacy of legislation to regulate harvesting and specific agreements, eg concession agreements
	Adequacy of human and financial resources to meet legislative and administrative responsibilities in sustainable forest management
	Community consultation
	Existence of management plans and provisions for their implementation

Sustainability at the Level of Forest Management

Resource security	The legal establishment of forest areas or management units
	Existence of a management plan
	Clear demarcation of boundaries in the field
	The presence or absence of illegal exploitation and Encroachment
	The duration of concession agreements
The continuity of timber Production	The presence of clear, official harvesting rules
	Long term soil productivity

	A pre-logging stand inventory
	The number of trees and/or volume of timber per hectare harvested
	Provision for monitoring the residual growing stock after logging
	Records of annual product output over time
	Net productive area
	Records of annual areas cut over time
The conservation of flora and fauna	Protection of eco-systems in the concession or management unit
	The extent of vegetation disturbance after logging
An acceptable level of environmental impact	Extent of soil disturbance
	Extent and spatial distribution of riparian and other watershed protection areas
	Extent and severity of soil erosion
	Provision for protection of bodies of water
Socio-economic benefits	The number of people employed
	The nature and extent of benefits from forest activities
Planning and adjustment to experience	Community consultation
	Arrangements for forest managers to take into account traditional forest utilisation.

12 Conclusions and recommendations

As forestry contributes about 10% of the national economy and a similar proportion of the country's export earnings the development of a sustainable industry is crucial to Vanuatu's future development. At first glance, a report on forestry in Vanuatu based on the ITTO criteria (Annex A) would suggest that Vanuatu is well on track towards the development of a sustainable forest industry. However, the situation is not as clear-cut as would first appear; there remain significant legal, institutional, social and technical constraints. The constraints and possible solutions are summarised below.

12.1 Legal constraints

Under the Constitution the powers of the Government to enforce land use policy is limited. Whilst the Government can regulate commercial forestry through licences for harvesting, processing and the sale of timber products, the Government does not have the power to enforce land use policy on traditional owners. The potential for land disputes in forest areas, or areas that have the potential for forest development, and the inability of the Government to resolve land disputes are disincentives to potential investors.

Recommendation 1: The Government should enact legislation that enables investors to gain security of tenure to forest resources through long-term leases with traditional owners.

12.2 Institutional constraints

At present Vanuatu does not have either national or regional land use plans. This is being addressed with the assistance of a current AusAID funded Land Use Planning Project, scheduled for completion in the year 2000. However, unless the administrative capabilities of both the central and regional governments are markedly improved they will not have the institutional ability to enforce national and sustainable land use planning effectively.

The DoF has plans to reorganise to give more authority in the regions, which will improve its management and supervision of forestry activities, and, under present arrangements, the DoF's activities can be fully funded from licence fees and other royalties. However, regional governments have a role to play in effective forest

management and it may be some years before they develop the necessary administrative capabilities to fulfil their role.

Recommendation 2: The GoV provides sufficient resources to improve the administrative capacity of the central and regional government bureaucracies.

Recommendation 3: The GoV approves the new structure of the DoF and provides it with sufficient resources to meet its legal obligations.

There is a general lack of skills in industry relating to planning, harvesting, timber utilisation, quality assurance and marketing. This is gradually improving but at present the industry is not using the resource efficiently and some of their practices are not conducive to natural regeneration.

Recommendation 4: The Government should finance a skills enhancement program from the Forestry Fund. This program should include sessions on the legal obligations regarding forest management under the Code of Conduct.

12.3 Technical issues

12.3.1 The Forest Resources Information System

There are still many gaps in the knowledge of the country's timber resources. The FRIS was completed in 1993 from aerial photographs and limited field sampling. The inventory provides estimates of commercial volumes of the limited number of tree species included in the sampling process, and was limited to trees >40 cm dbh. The estimates of volume were based on tree diameter alone producing one-way volume tables. Volume tables based on diameter and bole length must be developed to provide accurate volume assessments.

Recommendation 5: The DoF should initiate, as a matter of priority, a re-calculation of the resource on Espiritu Santo and Malakula.

Recommendation 6: Volume tables for all commercial species should be developed as soon as possible.

The FRIS is in danger of becoming out of date. At present FRIS can point to where potentially commercial stands of trees exist but the data are unlikely to be sufficiently precise to prescribe and control logging rates that are sustainable.

Recommendation 7: A FRIS Unit in the DoF should be established and provided with sufficient resources to update the database.

12.3.2 Regeneration

There is some disagreement over the success of natural regeneration. Applegate (1992) reported that with the exception of the commercially significant *Endospermum medullosum*, logged forests were regenerating well. This was disputed by Incoll (1994). Personal observation and comments by DoF staff during a field visit to Santo support the latter assessment. This is a major threat to sustainability.

Recommendation 8: The DoF should initiation a research program to:

- determine the current success of regeneration of the major commercial timber species; and
- develop methods to ensure successful regeneration of these species in native forests.

12.3.3 Silviculture

There is a lack of knowledge of appropriate silvicultural treatment for commercial timber species. The DoF research section, with the support of the EU, established spacing trails using several species in the Shark Bay ISP, and the DoF have established spacing trials of *E. medullosum* in the Melcoffee plantation in the Shark Bay area. Whilst some research has been done on *E. medullosum* (Haines and Walker 1995, Walker and Haines, 1995a and 1995b, Thompson, 1998) little is known of effective silvicultural treatments for other commercial native species.

Recommendation 9: Initiation of a research program to develop silvicultural regimes for the major commercial species.

12.4 Calculation of the sustainable rate of harvest

The calculations of sustainable harvest rates can be challenged. In addition to doubts on the accuracy of the data in FRIS all the calculations cited in Chapter 10 are based on the total national forest resource. This ignores the fact that at present the majority of commercial operations occur on Espiritu Santo. The three sawmills on Santo have an aggregate quota of 75,000m^3 but have only harvested 34,000m^3/year over the past four years. Based on the assumption the loggable forests of Santo/Malo contain 15m^3/ha of commercial wood then these forests only contain 475,500m^3 of loggable timber. At the present rate of utilisation this will deplete the resource in 14 years. Timber from Malakula could be shipped to the mills on Santo to make another 303,000m^3 available. However, a new sawmill being established in Malakula is expected to produce 10,000m^3/year. If the capacity of the new Malakula mill is added to the present utilisation of the Santo mills the combined resources of Santo/Malo and Malakula could be depleted in 17 years. This is well below the estimated rotation period for Vanuatu's forests. Due to the small resource base and lack of infrastructure and transport, it is not economic to ship logs to the sawmills on Santo from other islands of Vanuatu.

Recommendation 10: The DoF should review the sustainable cut on Santo and Malakula as a matter of urgency (this will have to follow Recommendations 5 and 6).

Recommendation 11: The DoF should consider reducing or elimination those current licenses where the licensee is not removing the full licence allocation and is never likely to do so in the foreseeable future.

12.5 Plantations

There is considerable scope for agroforestry and silvipastoral activity by landholders, particularly on Santo, and many are taking up this option. Whilst these small areas will, in time, provide a useful source of timber, the supply of a constant and reliable quantity of wood to industry can only be guaranteed by commercial plantations.

Recommendation 12: The GoV should investigate incentive packages to encourage landholders to engage in agroforesty.

Last *et al* (1996) examined the economic potential of plantations based on Brazilian mahogany (*Swietenia macrophylla*) gave an estimated yield of 378m^3/ha at 27 years. Assuming a veneer price of $US 350/m^3 and a sawlog price of $US 128/m^3, this would give an IRR of 14.5%. The estimations for *Endospermum medullosum* were also promising. Based on a veneer price of $US 180/m^3 and a saw log price of &US 80/m^3 an IRR of 12.7% after 27 years could be achieved (Last *et al,* 1996). A study by Groves (1997) came to a similar conclusion, suggesting that an IRR of 12.1% was possible after 25 years. The DoF has a long term lease over 6000 ha in Shark Bay and is actively seeking a commercial lessee to take up this option. It has been reported that *S. macrophylla* is not producing at such a rate in Fiji (Groves, pers comm, 1999), this raises some doubts over IRR estimates. Trial plots of several varieties of *Swietenia* have been established in Santo under an AusAID funded project.

Recommendation 13: The GoV should establish one or more model plantations to demonstrate their economic potential to investors.

12.6 The way ahead

Forestry in Vanuatu is at the crossroads. The Government seems to be committed to sustainability, and the DoF is developing the capacity to provide advice on how to implement sustainable forest management. However, if commercial forestry is to be sustainable it is imperative that the Shark Bay lease on Espiritu Santo is taken up quickly.

Overseas agencies have shown some interest in investment in the Vanuatu forest sector. The GoV could take action to stimulate private sector involvement by establishing a large to medium size plantation on Santo. Consultant reports have indicated that such an investment would be economically viable and the GoV could seek a loan for such a venture, the ADB is an obvious source of finance. The GoV will have to demonstrate stability and better governance if it is to secure loan funds.

12.7 Conclusion

Forestry in Vanuatu is not, at present, on a sustainable footing, but the framework is there for the GoV to develop a sustainable industry. To achieve sustainability the GoV will have to accept and implement the above recommendations. Failure to do so could lead to the exhaustion of commercial timber resources within 14 years.

Annex A

An assessment of the Vanuatu forest dector

National Level Indicators	Situation in Vanuatu
The forest resource base	
Comprehensive land use planning and provision for the permanent forest estate.	Government is establishing a Land Use Planning Office .
Present area of the forest estate in relation to national goals and targets.	Comprehensive forest policy issued in May 1997
Plantation establishment targets, present age age class distributions, and annual planting regimes.	Plantation targets part of government policy. Details yet to be published. Policy based on private sector investment.
Areas of protection forests and production forests within the permanent forest estate.	VANRIS provides good basis for planning. Forest areas of environmental significance have been identified for protection.
The continuity of flow	
National production of forest products over time.	Still subject of debate. Indications that present rate of harvest not sustainable as natural regeneration of commercial species is poor.
Documentation of logging history over time.	Available in DoF (record since 1982)
Proposed cutting cycle lengths for major forests types, and standard concession lengths.	Sustainable cutting cycle yet to be established. Interim planning based on 40 - 50 years. Concession lengths under negotiation.
Regulation of subsequent harvesting in relation to increment data and the net area of production forest.	Subject of research.
Steps taken to harmonise the first and subsequent cutting cycles and manage the transition from The first to the second cutting cycle.	Subject of research.
Wood production targets over time from various Sources.	Yet to be identified satisfactorily.
The availability of silvicultural prescriptions for the Major forest types.	Subject of research.
Environmental control	
Management prescriptions for other non-production Components of the permanent forest estate.	More emphasis needs to be given to non-wood products.
The availability of engineering, watershed protection and other environmental management prescriptions for production forests.	All included in the National Code of Conduct.

Availability of environmental assessment procedures.	Some provision in the Code of Conduct. Legislation for EIA under preparation.
Socio-economic effects	
Employment patterns and trends.	Industry is small, sufficient information available.
Income generation and distribution patterns.	Regulations govern distribution of royalties.
National review and expenditure budgets for forest management	Included in National Forest Policy Statement.
Institutional frameworks	
Availability of environmental assessment procedures.	In preparation.
Existence of a national forest policy.	Comprehensive policy issued May 1997.
The relationship of national policy to ITTO Guidelines.	Taken into account when drafting National Policy.
Adequacy of legislation to regulate harvesting and Specific agreements, eg concession agreements.	Forest Act under review.
Adequacy of human and financial resources to meet Legislative and administrative responsibilities in Sustainable forest management.	DoF able to meet core functions. Reorganisation and new regulations will assist DoF to meet responsibilities.
Community consultation.	Comprehensive consultation occurs.
Existence of management plans and provisions for Their implementation.	In preparation.
Forest level management	
Resource security	
Indicators of Forest Management.	In preparation by DoF.
The legal establishment of forest areas or Management units	Legislation exists, and is being improved
Existence of a management plan.	by DoF.
Clear demarcation of boundaries in the field	Yes based on VANRIS.
The presence or absence of illegal exploitation and Encroachment.	Not a problem in Vanuatu.
The duration of concession agreements.	Under negotiation.
Continuity of timber production	
The presence of clear, official harvesting rules.	Yes, part of the Code of Conduct.
Long term soil productivity.	Not a problem in most forest areas.

A pre-logging stand inventory.	Yes, in VANRIS.
The number of trees and/or volume of timber per hectare harvested.	Records kept by DoF.
Provision for monitoring the residual growing stock after logging.	Poor rate of natural regeneration is a major risk to sustainability.
Records of annual product output over time.	Maintained by DoF.
Net productive area.	Indentified in VANRIS.
Records of annual areas cut over time.	Records kept by DoF. Registration of small scale sawmills will improve data.
Conservation of flora and fauna	
Protection of eco-systems in the concession or management unit.	Forest management plans and Code of Conduct provide reasonable protection.
The extent of vegetation disturbance after logging.	Impact of logging being reduced by enforcement of Code of Conduct.
Environmental impact	
Extent of soil disturbance.	Decreasing - not a major problem.
Extent and spatial distribution of riparian and other watershed protection areas.	Not a major problem.
Extent and severity of soil erosion.	Not a major problem.
Provision for protection of bodies of water.	Some - will improve when Environment and Water Acts are passed by Government.
Socio-economic benefits	
The number of people employed.	Difficult to assess as numbers employed by small sawmills not known.
The nature and extent of benefits from forest activities.	Emphasis on development of local timber processing industry maximises benefit at local level.
Planning and adjustment to experience	
Community consultation.	Extensive at regional and local level.
Arrangements for forest managers to take into account traditional forest utilisation.	Essential under Vanuatu's land tenure system.

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